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BAHRAIN SOCIETY OF ENGINEERS

Al-Dur Solar Power Plant Project
With a capacity of 100 megawatts

A Journey with

Engineer Mohamed Abdulkhaliq

The triad of:

Civil engineering,

Real estate development, and

Volunteer work.

bsemohandis

BAHRAIN SOCIETY OF ENGINEERS

P.O. Box: 835, Manama

Kingdom of Bahrain

Email: mohandis@bse.bh

Website: www.bse.bh

Please send your articles to:

Bahrain Society of Engineers

Tel: +973 1772 7100

Fax: +973 1782 7475

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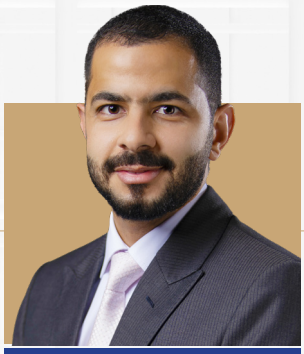

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Professor
Isa Salman Qamber

As it is well known, the Bahrain Society of Engineers (BSE) has undertaken the transfer of Bahraini engineering expertise to benefit both the young generation of engineers and experienced engineers. This is achieved through interviews with engineers who have a proven track record in engineering work, as well as through the content of the journal's issues, which cover various engineering projects. Moreover, the BSE goes beyond that by showcasing selected award-winning projects highlighted in the Al-Mohandis Magazine through the activities of BSE, thereby fostering a spirit of competition among engineers. Additionally, the Society has selected summaries of various university graduation projects and benefited from engineering topics in both Arabic and English to promote engineering knowledge and culture.

The Bahrain Society of Engineers Award (BSE Award) is known as an annual award that aims to motivate Bahraini engineers toward innovation and excellence in the engineering field, while recognizing their outstanding achievements and contributions to society and the nation. This issue includes a summary of five winning projects across various engineering disciplines.

The first project proposes the establishment of an innovation and education center. The center integrates sustainable design and renewable energy solutions to enhance efficiency, environmental performance, and specialized laboratory functions.

The second project implements and compares five control strategies for an artificial pancreas using the validated Hovorka glucose–insulin model under hypoglycemia, hyperglycemia, and meal disturbance conditions.

Engineer Mohamed Abdulkhaliq Aldelawar, a civil engineer and Bahrain Society of Engineers (BSE) member, began his career without a set university path but chose civil engineering for its connection to daily life. He has worked across various fields, including technical, administrative, legal, insurance, and real estate development, with major projects such as Ain Adhari Park and Tala Island. Engineer Mohamed was an early BSE student member, later contributing actively to committees and notably helping organize the Bahrain International Property Exhibition (BIPEX). He advises young engineers to value their analytical thinking and pursue continuous self-development. Ultimately, he emphasizes that engineers play a vital role in societal development and must take pride in their professional responsibility.

The Electricity and Water Authority in Bahrain is constructing the 100 MW Al Dur Solar Power Plant, which will utilize 135,000 solar panels to produce 197 GWh per year and reduce emissions. The new project is expected to diversify the energy mix, reduce dependence on fuel, and support the country's goal of achieving 20% of its energy from renewable sources by 2035 and carbon neutrality by 2060. The project's cornerstone was laid in December 2025, and the plant is expected to be completed in 2026 and managed by Bahraini engineers.

Five winning projects organized by Bahrain Society of Engineers (BSE) summarized in this issue. The first project is a library that is a hall social gathering place for learning and thinking, where cultural heritage is conserved and shared for the benefit of all.

The essence of a library is to empower society, protect the past, ignite innovation, and bridge the gap between generations through shared knowledge.

The second project is a biomedical project that focuses on the development of a portable and affordable hyperspectral imaging system that non-invasively diagnoses allergies by imaging the skin's response beneath the skin's surface, making the need for conventional testing obsolete. The system, which incorporates a miniaturized optical system and compressive sampling, decreases the system's hardware costs and makes it more accessible to people of all skin tones and locations.

A third chemical project created AeroDoctor, an environmental drone that continuously tracks real-time air pollution

levels in Bahrain and sprays water to decrease particulate matter, resulting in an average reduction of 17.21%. The cost-effective system effectively tracks seven air pollutants and proves the potential of drone swarms to greatly enhance the country's air quality.

The Civil project designed a landmark mixed-use facility in Bahrain Bay featuring a luxury mall, offices, and a museum with a large aquarium, all with a sea-inspired glass facade. The project also includes more than 700 parking spaces and public transportation access, with the goal of meeting commercial, recreational, and cultural needs.

The last project is a Mechanical project designed and optimized a 316L stainless steel coronary stent with 429 MPa radial strength and 0.458 fatigue usage factor using multi-objective optimization of strut design. The optimized design strikes a balance between flexibility and strength while restoring artery diameter to 4 mm with 26.7% coverage, as required for clinical applications in treating coronary artery disease.

The education in architecture requires an 'updated pedagogy' that will 'systematically integrate new technologies' such as BIM, VR, and digital twins, going beyond the 'current deficiency in structured methodologies.' Dr. Wael Abdul-Hameed in both languages Arabic and English goes through that in his articles. The new pedagogy will 'actively guide students in understanding how these new technologies, together with new materials and systems, change design processes, thinking, and architectural forms.' By 'systematically evaluating these changes,' a 'creatively based' framework can be developed to 'prepare students to effectively combine old and new methods in their future practice.'

The article by Dr. Hosni Mohammed Al-Zubeir titled 'The crucial transition from fossil fuels to clean electricity in the chemical industry to fight climate change' focuses on the electrification of the chemical industry through electrochemistry, which is a highly effective way to achieve a sustainable chemical industry. Although there have been major breakthroughs in chemical engineering (especially in green hydrogen), there are still significant hurdles in terms of cost, high-temperature technology, and process change. It is important to continue this joint effort between research and industry, especially in the area of reactor innovation. This transition is much more than a technological shift; it is one of the key foundations of a decarbonized industrial future.

Concrete is a versatile composite material composed of cement, water, and aggregates, whose properties, such as workability, strength, and durability, are determined by its composition and curing process.' Engineer Hani Al-Khayat went through it in his English article. Though it 'excels in compressive strength and fire resistance for a wide range of applications from buildings to dams,' its 'low tensile strength requires reinforcement, and it needs careful handling to reduce problems of shrinkage and environmental effects.

In an achievement added to the record of national engineering successes, Niche Magazine has honored both Engineer Ameen Radi and Engineer Maysam Al-Nasser in recognition of their distinguished professional careers and influential presence in the field of architecture. The magazine recognized them and named them among the list of the best engineers in the Middle East for the year 2025.

Four graduate students' projects are summarized in the present issue. The first project worked on a smart distribution board with real-time monitoring, remote control, and a priority-based load-shedding algorithm to improve safety and energy management in residential panels. The project combines customized power-metering hardware with an IoT platform, has been tested in the lab, and offers a starting point for future smart home integration.

The second research project examines the effect of harmonic distortion on industrial power systems, simulating the effect and developing harmonic filters to successfully improve power quality according to IEEE 519 standards. The results provide recommendations for improving harmonic performance in industrial power systems, especially in Bahrain.

The third project successfully implemented a low-cost, FPGA-based constant V/f control system for three-phase induction motors using an Altera DEO-Nano board and Verilog HDL. The project shows that FPGA technology, with its direct hardware coding and modular approach, provides a flexible and cost-effective alternative to conventional DSP-based or high-end FPGA motor drives.

The fourth project developed a smart, automated injection system that provides controlled doses of medication while monitoring for errors. The successfully tested prototype shows that the system is accurate and safe for drug delivery, and provides a basis for further development for medical use.

A Journey with an Engineer

Engineer Mohamed Abdulkhaliq Aldelawar

The triad of: Civil engineering, Real estate development, and Volunteer work

In this issue of Al-Mohandis magazine, we feature a prominent figure in the field of engineering. Our guest is a member of the Bahrain Society of Engineers (BSE) who has advanced through the ranks of the engineering profession, starting from his specialization as a civil engineer. He has practiced engineering in both its direct technical aspects as well as in administrative and legal engineering domains. He has also applied his expertise in the fields of engineering insurance and real estate development.

Engineer Mohamed Abdulkhaliq Aldelawar, welcome as our esteemed guest in the eighty-fifth issue of Al-Mohandis magazine.

To begin with, the readers of Al-Mohandis magazine would like to briefly learn about Engineer Mohamed Abdulkhaliq Aldelawar's upbringing and early educational journey.

I was born on June 19, 1971, in Al-Dhawawda Area, Manama – a neighborhood situated in the heart of the areas of Al-Hoora, Ras Ruman, and Al-Awadhiya. I began my primary education at Al-Rasheed Primary Boys School from first to third grade. I then moved to Ras Ruman Primary School for fourth grade, and subsequently transferred to Al-Ma'mun Primary School for fifth and sixth grades, which was a new school in Al-Hoora at the time. I then moved on to Abdul Rahman Aldakhil Intermediate Boys School, followed by Shaikh Abdulaziz bin Mohammed Al Khalifa Secondary Boys' School, in the scientific track, specializing in Physics and Mathematics.

Were you influenced as a student during your secondary education by any engineering figure who helped shape your university path and your choice to study engineering, particularly your decision to specialize in civil engineering?

To be honest, upon graduating from secondary school, I did not have a specific direction for university studies. Along with several of my fellow graduates, I visited the University of Bahrain to apply for admission. There, we

Engineer Mohamed Abdel Khaleq (first from the right) during one of the student activity events at the University of Bahrain

found various academic programs. Given my scientific track in secondary school (Physics and Mathematics), and my strength in mathematics and the sciences, my inclination leaned more toward studying engineering. Encouraged by my friends, I enrolled in engineering, even though I had never previously intended to study it.

I chose civil engineering because I felt it was more closely connected to everyday life—such as the buildings and structures around us—which made me want to get closer to this engineering field, that is, to engage with tangible reality.

There is no doubt that the university phase was extremely important for my personal development, not to mention the academic side, which was the primary reason for my being at university. However, I was also very active in student work and various student activities. This contributed significantly to shaping my personality after university and throughout my professional career. I found that my involvement in student activities at university was a key factor in developing my future character and my subsequent progression through the positions I later held.

During my university studies, I served as a member of the Board of Directors of the College of Engineering Student Society for four years, including three years as a board member and, in the fourth year, as President of the Society. Joining this society at the time helped me engage in many areas of volunteer work of various kinds. I believe this later encouraged me to join the Bahrain Society of Engineers and become involved in volunteer work there, as well as in other volunteer activities that I have undertaken—and continue to undertake to this day—alongside my professional field.

How did your professional career in engineering begin, and what positions have you held in this field?

After graduating from university, I began my professional journey. I was fortunate to work in several diverse areas,

Engineer Mohamed Abdel Khaleq during a television interview on the program "The Economic Council."

practicing engineering in its direct technical aspects as well as in the administrative and legal engineering domains. I was lucky to have this diversity, which is important as it demonstrates the engineer's ability to work across different fields and excel in all of them. Among my roles was working in the insurance sector, and I was one of the first Bahraini engineers to work in this field, at a time when it was just emerging. Initially, I was surprised when I was offered the opportunity to work in insurance, as there were no engineers working in this field back then. However, once the role of engineering in insurance was explained to me, I was encouraged to work in this area for a period, and I delved deep into it—particularly in engineering insurance. There are various types of engineering insurance, including development project insurance, building insurance, facility and factory insurance, and professional liability insurance for engineers. This field has depth and requires the engineer's involvement in these different types of insurance. So I entered this field, specialized in it, even studied insurance, and managed to bridge the gap between engineering and insurance—something I consider an excellent addition for me personally, as well as for the insurance sector, from the perspective of an engineer working in insurance. Thanks be to Allah, I succeeded and worked in this field for a considerable period, handling various projects. I exited this field with solid experience and excellent professional relationships, and I remain in close contact with them.

In this regard, I have provided numerous consultations, including one for the Association of Engineering Offices regarding the insurance required by the Committee (now the Council) for the Regulation of the Practice of Engineering Professions (CRPEP), concerning insurance for engineers and engineering offices.

We would be pleased if you could briefly review, within the engineering field, the positions you have held in real estate development.

I worked in real estate development at the Al Khaleej Development Company. Through this company, I worked on several projects, including well-known ones such as the Ain Adhari Park project, which was one of the

major projects I worked on as a developer and as the representative of the owning company. I also worked on the Tala Island project in Amwaj Islands, which is one of the key residential projects in Bahrain and among the early gated residential communities in the country—considered a model for such developments. In addition, I worked on several other projects, including Bahrain Investment Wharf (BIW) and the Industrial Area, as well as Durrat Marina and many other real estate projects.

In these projects, my role encompassed both the engineering and administrative sides, which was an important aspect of the projects I was involved in. Naturally, part of my work at the company also involved the investment side, as the company evolved into an investment firm and was renamed Inovest. Through Inovest, I played a role in various other projects beyond real estate, including industrial projects, financial companies, and the establishment of different enterprises, among them a pharmaceutical factory in the Hidd area, where I had a significant role.

These diverse projects across Bahrain are highly dynamic. On a personal level, in addition to the technical engineering aspect, I also played a role in the administrative, financial, and legal sides of these projects and the company's overall activities (Inovest).

After that, I moved to work at the Yusuf Bin Ahmed Kanoo Group, where I was responsible for the company's real estate portfolio. I served as the Executive General Manager, with all technical and administrative work under my responsibility, including development, project management, property management, and other functions.

Subsequently, I devoted more time to consultancy work and corporate board memberships, which also involve a great deal of activity. Currently, I am a member of the Board of Directors of BE Properties Company, a real estate company affiliated with Bapco Energies, which manages all energy operations in Bahrain. This company is primarily concerned with the group's real estate assets, the most

During one of the events at Bayan Bahrain School

significant of which are Awali Township and the Bapco Club—the group's club. These are also part of my current work.

Additionally, I have commitments on several boards. I am a member of the Council of Minors and their Equivalent Funds Guardianship, and I serve as the Chair of the Financial and Real Estate Investment Committee within the Council. I also have a substantial role in administrative matters related to the real estate assets of the investment portfolios under the management of the Guardianship Council for the Assets of Minors and Their Equivalents. These are also among the activities I carry out, both on the technical and administrative sides, and they are, of course, voluntary in nature.

How did your affiliation with the Bahrain Society of Engineers begin, and what activities have you undertaken?

My involvement with the Bahrain Society of Engineers began during my university studies. I attended some

During the opening of one of the real estate exhibitions at City Centre Mall

events at the Society and was among the first members of the (Student) category, as the Society had just started accepting membership applications for this category at the time. I was part of a group of students who applied for membership, which was in the early 1990s.

As previously mentioned, my membership with the Society began during my university years as a student member, and I participated in various activities offered by the Society at that time. After graduation, I converted my membership to (Active Member), and I took part in several Society committees, contributing to various activities. I also made a point of attending numerous conferences and events organized by the Society, including technical and social activities, which I consistently strive to attend.

In truth, I consider myself a supporter of the Bahrain Society of Engineers and one of those who firmly believe in the importance of its role in Bahraini society from various perspectives, including the development of engineers. The Bahraini engineer is an active and supportive element in diverse engineering fields. Training and developing engineers, and subsequently providing job opportunities for young engineers through engagement with various entities that graduate engineers may find difficult to approach—the Society has played a major role in facilitating and enhancing communication between engineers and government bodies responsible for job placement. The Society has played, and continues to play, a significant role in developing engineers and preparing them for employment.

Furthermore, the Society undertakes numerous tasks, activities, and events, including conferences and workshops that contribute to the development of engineers and promote engineering awareness among both engineers and non-engineers. The Society's role is also evident through various committees, such as government committees, boards of directors, and

During one of the events of the Council on the Guardianship of Minors' Assets

various specialized councils, whether governmental or civil society. The Bahrain Society of Engineers has an important role in participating in the work of these institutions or various events that support engineering work in Bahrain in general, and that support the Bahraini engineer's work, skill development, and progress.

Therefore, the role of the Bahrain Society of Engineers is important and highly effective for both society and the engineering sector. Conversely, engineers joining the Society has its own significant impact and importance. Hence, I especially advise young engineers to play a role in the Society's activities, either by directly contributing to organizing and delivering activities or by attending the various events and activities organized by the Society and benefiting from them.

On the level of professional experience and in the field of consultancy, I have provided consultations on various aspects, including investment matters. Among my contributions was participating in providing consultations to the Society's investment-related committees, which made proposals for investing the Society's funds, in addition to other activities such as serving on various committees, including the evaluation committee for the Distinguished Engineer Award and chairing the evaluation committee for the Distinguished Engineer Award in its two categories: Young Engineer and Experienced Distinguished Engineer.

Drawing on your experience in the real estate development sector, how does Engineer Mohamed Abdulkhaliq view the Bahrain Society of Engineers' experience in organizing the Bahrain International Property Exhibition (BIPEX)? And what does this experience mean to you on a professional level?

Among the tasks and events I recall and consider among the most important and prominent of my contributions to the Bahrain Society of Engineers is my membership and role on the organizing committee of the Bahrain International Property Exhibition (BIPEX), which the Society organized for several editions starting in 2009. I consider this experience a highly significant one for the Bahrain Society of Engineers, as well as for myself within the Society and on a personal professional level.

As an engineer in the real estate development field, launching a property exhibition in Bahrain was, in my view, a much-needed initiative at that time, given the

With His Royal Highness Prince Khalifa bin Salman Al Khalifa, the former Prime Minister, may Allah have mercy on him, at one of the real estate exhibitions

real estate market boom in the early 2000s. We began with the Society organizing the Bahrain International Property Exhibition (BIPEX), which initially was a small exhibition held at a hotel. Through diligent, well-planned efforts and careful planning, it evolved into a major exhibition at the Bahrain International Exhibition Centre, with participation from a larger number of real estate companies. My company was among the first to contribute and participate in this exhibition, taking up the largest pavilions. After that, BIPEX exhibitions took off significantly.

My participation in this exhibition was both as a member of the organizing committee and as a participant through the company I represented. Both within the Bahrain Society of Engineers and from the company's perspective, we found that this exhibition served as an important driver for the real estate market during a period of market growth, as a property exhibition was a key requirement for the real estate market in the Kingdom of Bahrain. The Bahrain Society of Engineers' initiative to launch this exhibition was a significant and strategic move. This exhibition served as a model and an encouragement for other property exhibitions held at that time, some of which continue to be held to this day.

What are the most significant memberships or commitments that Engineer Mohamed Abdulkhaliq has been or continues to be engaged in presently within the field of volunteer work?

Throughout my professional career, alongside my job, I have been involved in volunteer work and other non-professional activities. These have taken the form of either my memberships and commitments to various activities within the Bahrain Society of Engineers, or a range of other endeavors, such as certain roles with the Bahrain Chamber (formerly the Bahrain Chamber of Commerce and Industry). I have participated through my membership

An honoring by His Excellency Shaikh Khalid bin Abdulla Al Khalifa, Deputy Prime Minister, at one of the exhibitions

With the Prime Minister of the Republic of Albania during my participation as a speaker at a real estate conference in Albania

Engineer Mohamed Abdel Khaleq in his office at Gulf Real Estate Development Company

in several committees, including the Bahrain-T rkiye Business Council, as well as through the joint committee between the Chamber and the Ministry of Justice, Islamic Affairs, and Endowments. I have also engaged in other volunteer activities. For instance, I served as a board member of the Bahrain Federation of Sports for All for a single three-year term. Additionally, I was the Secretary-General of the International Federation of Sports for All for three years. I have also held other roles in various activities, such as serving on the Board of Directors of Bahrain Bayan School, and chairing the school's Finance and Audit Committee for ten years. These are some of my other volunteer activities, which form part of a broader range of contributions in the field of volunteer work.

To conclude this interview, we would be grateful if you could offer a word or advice to our young engineers across all engineering disciplines, coming from an engineer with extensive experience.

I would like to say that the engineering field is extremely important for societies in general. Societies are built on the work of engineers in development, and they are run by engineers—factories are managed and advanced by engineers. Engineers play a major role in the economy of any country, as well as in its development and progress. Young engineers must understand the importance of their profession in their society, take pride in this role, and recognize the level of commitment and responsibility they bear as engineers toward their community in terms of societal development, supporting various endeavors, and fostering innovation and progress. Society needs engineers to fulfill these roles to advance their communities.

Moreover, an engineer must be aware of the significance of their role in the communities they serve. They should not be content with their degree for development and learning; rather, they must continue to attend various professional events and activities, such as technical workshops and

His Excellency Shaikh Khalid bin Abdulla Al Khalifa, Deputy Prime Minister, honoring Engineer Mohamed Abdel Khaleq among the pioneers of Gulf engineering work at the 26th Gulf Engineering Forum in the Kingdom of Bahrain (2025)

conferences, and pursue self-development through advanced degrees. Self-improvement is crucial, especially in a time like this, marked by intense competition in the job market.

I also encourage young engineers to continuously broaden their knowledge, develop themselves, trust in their abilities, and recognize that these abilities are of a high caliber. As an educated individual in the engineering field, possessing key attributes such as analytical thinking—which provides a broader perspective in the workplace and opens up wider career opportunities when the right chance arises—young engineers should leverage these strengths.

Furthermore, while young engineers have job opportunities in direct engineering fields, there are many areas related to engineering that require the analytical thinking essential to engineers, even in work far removed from direct engineering. Engineers can excel in other domains that demand analysis, such as investment. The field of investment, dealing with numbers and transactions, requires analytical thinking, and engineers are among the most well-suited individuals to work in this area. Engineers can also work in fields outside the engineering sphere, including investment and management.

In general, after a period of engineering work, an engineer may be well-prepared for a managerial role. By developing their management skills, they can become successful managers due to their analytical thinking, as management work heavily relies on analyzing information and data, upon which managers base their decisions. After excelling in their engineering domain, engineers who develop themselves in management will reach advanced stages as successful managers, thanks to their broad perspective. They will also be open to other activities that contribute to their development and help them play a role

Al Dur Solar Power Plant Project with a capacity of 100 MW

Introduction

The Electricity and Water Authority of the Kingdom of Bahrain is executing within a strategic plan aimed at improving energy efficiency and rationalizing electricity consumption as part of national efforts to achieve carbon neutrality by 2060. To achieve this goal, the Authority is working on several initiatives, most notably the National Renewable Energy Plan, which aims to enhance energy security, diversify its sources, invest in and encourage the use of renewable energy, and provide an energy mix to secure the future needs of the Kingdom of Bahrain. By providing a diverse energy mix, the Kingdom seeks to citizens and residents at the highest level of quality and performance. The Authority is keen to develop its performance to increase effectiveness and production, and to improve service delivery to keep pace with the comprehensive development process the country is witnessing under its wise leadership.

This plan provides new investment opportunities in the fields of renewable and clean energy, and the development of modern technology related to energy. It supports efforts to enhance cooperation with local and international partners to achieve sustainability goals in the energy sector, balancing current energy needs with the sustainability of natural resources for future generations, combating climate change, and preserving the environment.

General Project Objectives

This project falls within the objectives of the National Renewable Energy Plan to achieve sustainable development by reducing reliance on local or imported liquefied natural gas, increasing the share of renewable energy in the total energy mix to reach 20% by 2035, and achieving net-zero emissions by 2060, in line with environmental protection and the Kingdom of Bahrain's international climate commitments. Due to the significant amount of energy that will be generated by the project, it will be connected directly to the electricity grid on Utility-scale facility or Utility-scale plant.

His Excellency Shaikh Khalid bin Abdulla, Deputy Prime Minister, laid the foundation stone for Al Dur Solar Power Plant project on Thursday, December 25, 2025, in the presence of His Excellency Engineer Kamal bin Ahmed Mohammed, Chairman of the Electricity and Water Authority (EWA), and a number of Their Excellencies the Ministers and senior officials.

Strategic Project Objective

Al Dur Solar Power Plant Project aims to invest in advanced technologies, which are a fundamental pillar in the development of modern infrastructure, particularly in sectors related to supply security and service continuity. Foremost among these is the integration of solar energy solutions into the electricity production system, given its role in diversifying production sources, enhancing the flexibility of the electrical grid, and achieving environmental and economic returns that support sustainable development goals.

Deputy Prime Minister lays the Foundation Stone for the Al Dur Solar Power Plant Project:

His Excellency Shaikh Khalid bin Abdulla Al Khalifa, Deputy Prime Minister, accompanied by the President of the Electricity and Water Authority and a number of Their Excellencies ministers and senior officials, laid the foundation stone for the Al Dur Solar Power Plant Project on Thursday, December 25, 2025.

"The Al Dur project represents a significant addition to efforts to develop the energy sector. Its impact is not limited to providing new production capacity from a renewable source, but extends to supporting the national direction towards the phased expansion of integrating renewable energy into the energy mix, targeting 20% by 2035. This falls within the framework of the National Renewable Energy Plan and its objectives related to energy security, diversification of energy sources, stimulating investment, and creating job opportunities in the renewable energy industries."

"The establishment of the Al Dur plant as one of the utility-scale solar power plants, connected directly to the electrical grid, reflects the Kingdom's direction towards implementing centralized production projects capable of contributing tangible quantities to the electricity system, in line with developmental requirements and future energy needs."

His Excellency
Shaikh Khalid bin Abdulla Al Khalifa
Deputy Prime Minister

"The production capacity of the Al Dur Solar Power Plant Project, upon its completion by the third quarter of next year, is scheduled to reach approximately 100 MW, using 135,000 solar panels.

His Excellency
Engineer Kamal bin Ahmed Mohamed
The President of the Electricity and Water Authority

His Excellency the President of the Electricity and Water Authority,Engineer Kamal bin Ahmed Mohamed explained that the project is one of a package of projects implemented by the Authority, both in the field of distributed solar energy and on a utility scale, contributing to reducing reliance on traditional fuel, supporting national efforts to reduce emissions, and contributing to achieving the Kingdom of Bahrain's commitment to reaching carbon neutrality by 2060.

Project Overview

- It is the first project of this scale for clean energy production in the Kingdom during the year 2024.
- Production capacity reaches up to 100 MW.
- The project will be implemented over a total area of 830,000 square meters.
- Number of solar panels: 135,000 solar panels, with a capacity of 710 watts per panel.

• Number of inverter stations: 16, with a capacity of 6.6 MVA per central unit.

• Project contractor: The Chinese company TBEA International Engineering Co.

• Implementation period: 18 months, and the plant is expected to become operational in the third quarter of 2026.

• The plant is expected to generate approximately 197 GWh of electrical energy annually over its 25-year operational lifespan, which will contribute to reducing carbon emissions by about 98,000 tons per year.

The Role of Bahraini Engineer in the Project Implementation

The Bahraini engineer plays a prominent and distinguished role in the solar energy projects planned and executed by the Electricity and Water Authority. Numerous Bahraini engineers, both experienced and recent graduates from the Authority, have participated in the project's study and planning work since its early stages. This included preparing the technical specifications and main tender documents, evaluating bids submitted by companies, reviewing the final designs, and supervising the execution of construction work on site. This project has contributed to gaining practical experience and developing the skills of newly graduated engineers, preparing them to manage similar solar energy projects in the future.

Images of the foundation stone laying ceremony with His Excellency Shaikh Khalid bin Abdulla, Deputy Prime Minister, and images from the construction site of the Solar Plant.


EWA
هيئة الكهرباء والماء
Electricity & Water Authority

The Six^thBahrain Society of Engineers Award

Introduction

The Bahrain Society of Engineers Award is an annual award aimed at motivating Bahraini engineers to innovate and excel in the engineering field, while recognizing their outstanding achievements and contributions to society and the nation. The award is divided into three main categories:

1. Lifetime Achievement in Engineering Award
2. Outstanding Engineer Award
3. Best Graduation Project Award

There are four main objectives of the award, summarized as follows:

1. Honoring Excellence:

Highlighting the remarkable achievements of Bahraini engineering professionals throughout their careers and their service to Bahrain's industrial community.

2.Supporting Innovation:

Encouraging creativity and innovation in the engineering field by promoting smart and sustainable solutions.

3. Inspiring Students:

Fostering a spirit of creativity and innovation among engineering college students and encouraging their outstanding graduation projects.

4. Enhancing Competitiveness:

Creating an environment of scientific and creative competition among engineers.

This issue highlights five award-winning projects.

1 Architecture

A Fusion of Culture, Innovation and Timeless Knowledge

Student:

Wadeea Ali Ahmed Helal

Supervisor:

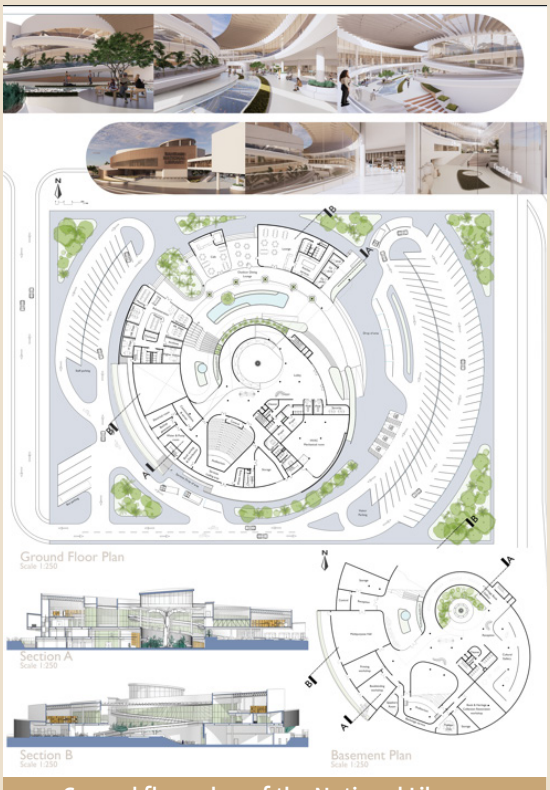
Prof. Islam El Ghonaimy

A library is more than just a place for books. It is a safe, sacred space dedicated to learning, reflection, and intellectual growth. In a fast-spaced, digital world, it offers stillness and depth, inviting people to connect with knowledge in a meaningful, almost spiritual way. It protects cultural memory, fosters curiosity, and provides a communal haven for lifelong learning. The objectives of the project are summarized in four points. These points are:

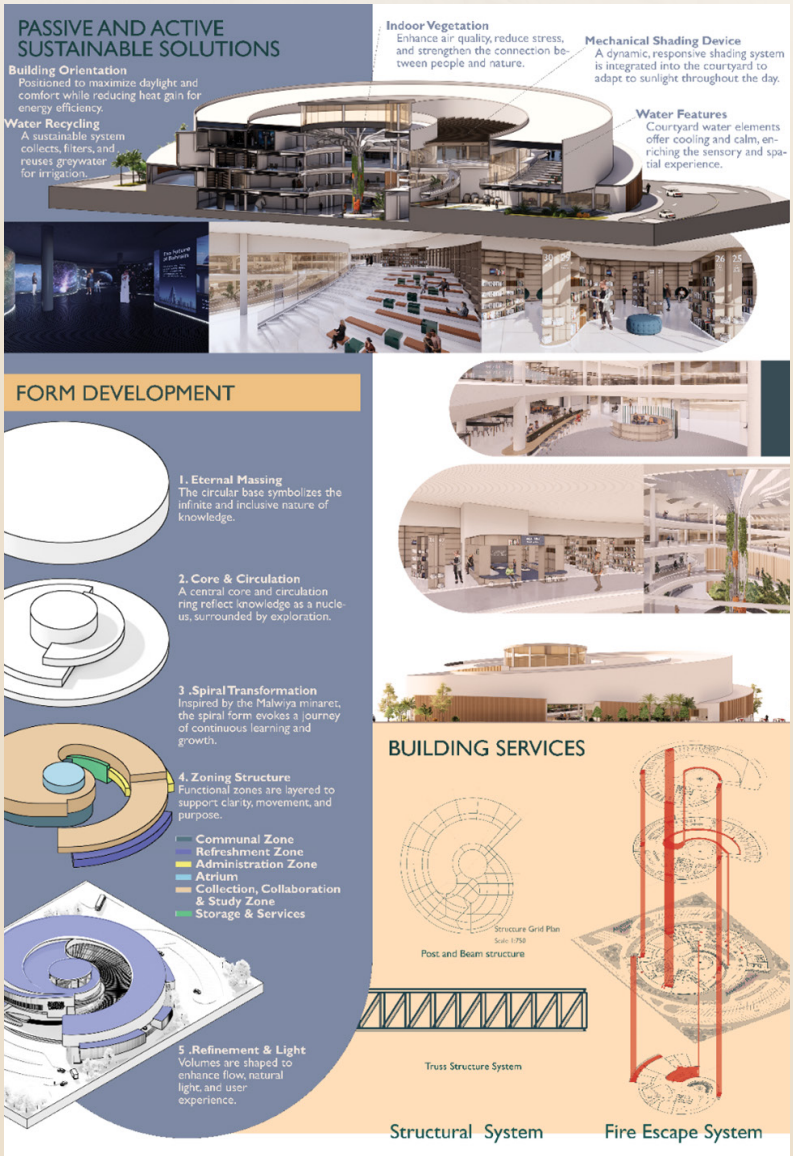
a) Empower Communities: Offer inclusive access to resources, spaces, and learning tools that support social growth and personal development.

b) Preserve Heritage: Safeguard Bahrain's cultural memory through manuscripts, oral history, and archival material.

The first and second floors of the National Library



Ground floor plan of the National Library



Sustainable passive and active solutions

c) Ignite Innovation: Inspire creative thinking and digital fluency through tech labs and collaborative environments.

d) Connect Generations: Bridge past, present, and future – providing timeless knowledge for today's learners and tomorrow's leaders.

2

Biomedical Engineering Project

Novel Low-cost Hyperspectral Imaging device

Students:

Maryam Salman

Vareesha Uddin

Jessica Wojtowicz

Leyan Khal

Kevin Jin

Daniel Robles

Supervisor:

Dr. Christine King

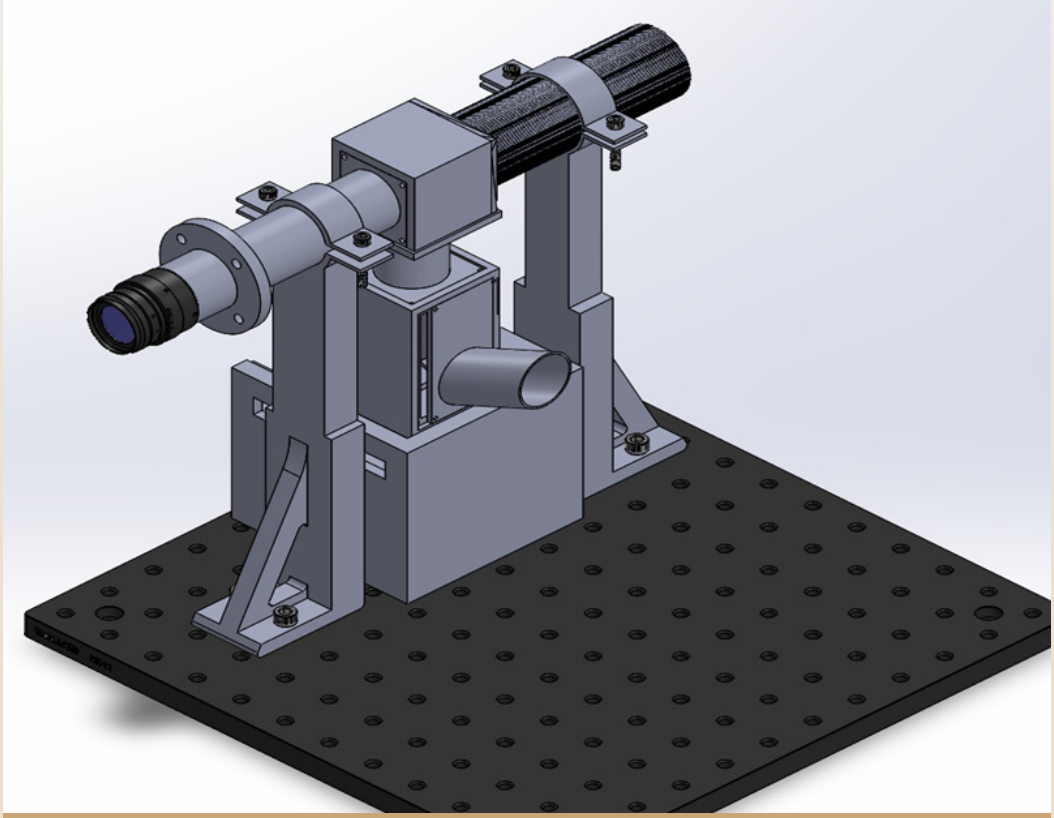
The project seeks to eliminate the cost barrier and discomfort associated with traditional allergy testing, while addressing the disparity of allergists in global populations, by creating a non-invasive, low-cost, portable, and accessible version of traditional hyperspectral imaging systems to be used for rapid allergy diagnosis.

Our optical setup allows for a compact design, enabling device portability.

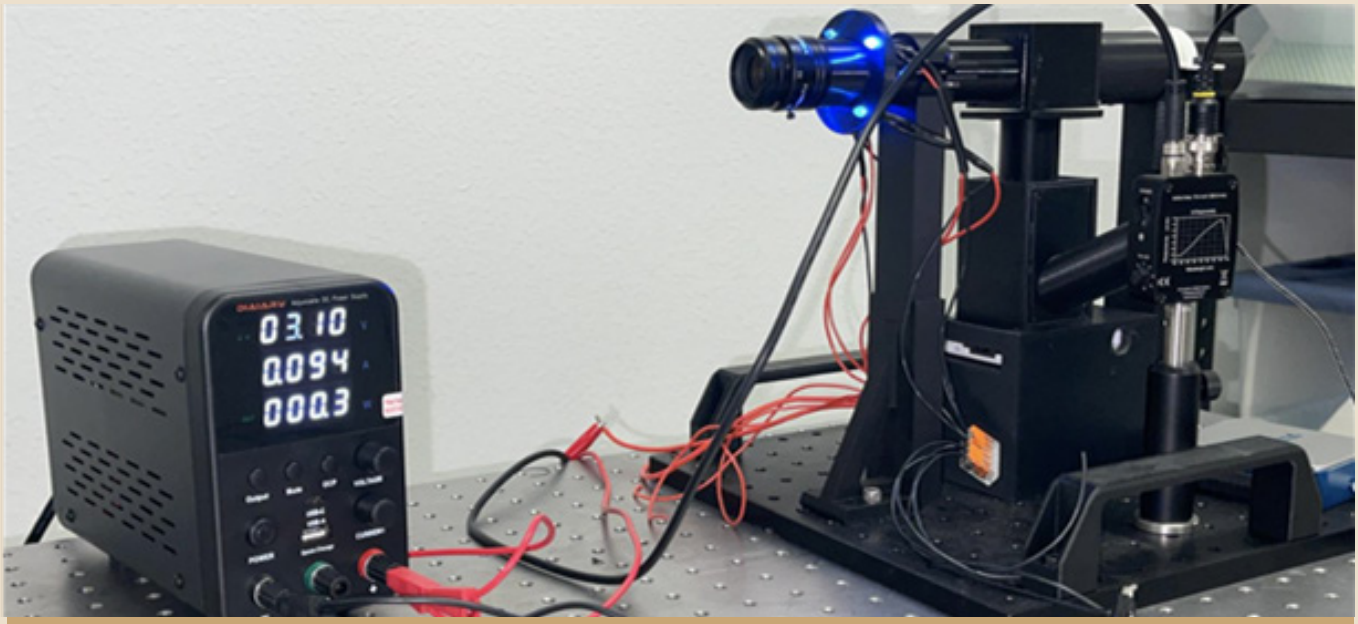
By enabling dense sampling across a spectral range of ~400-1700 nanometers, hyperspectral imaging allows our device to visualize processes occurring below the surface of the skin. This provides for a non-invasive method of evaluating allergic reactions regardless of skin color thus increasing patient accessibility.

Our results demonstrate successful simulation of the Hadamard-based single-pixel imaging process as well as validated photodiode responsiveness to binary patterns. These results establish a solid foundation for future hardware integration and hyperspectral imaging. By combining compressive sampling techniques and a single pixel imaging setup, our device uses fewer components than traditional cameras. This reduction in the hardware and optical components required allows for our device to be offered at a lower cost, further contributing to accessibility.

As a conclusion, the MATLAB code demonstrates the image recovery process through the use of Hadamard-based single-pixel imaging. An image of a square target was captured through our device and reconstructed through a sample code to simulate the expected output once the DMD is successfully integrated into the device.



Integrating individual parts into a single model



Final prototype of the project

3

Chemical Engineering

Monitoring, Analysis, and Countering of Air Pollution Using The AeroDoctor Technology

Students:

Mohamed Hussam Kamal Zainuddin

Fatema Salah Ahmed Hasan

Supervisor:

Dr. Raed E. Al-Jowder

Co-supervisor:

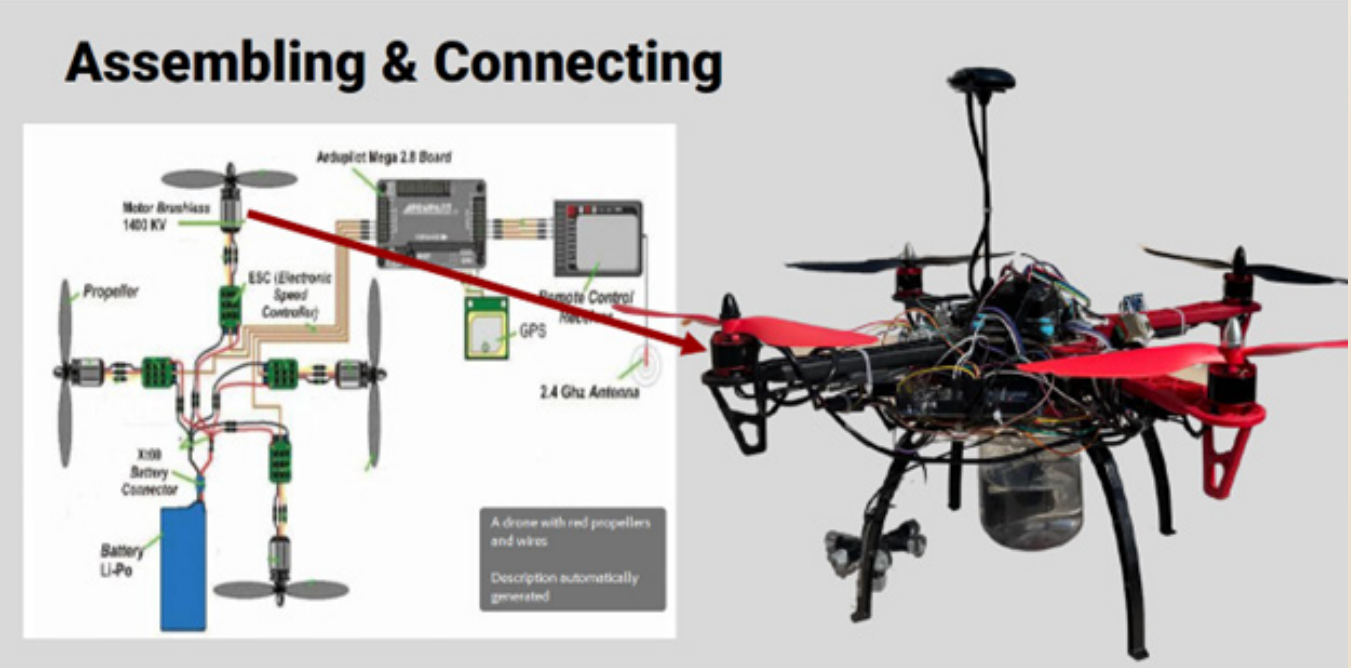
Mrs. Bintu Jasson

The project is an environmental drone—AeroDoctor—was designed to monitor, analyze, and counter air pollution. The main objectives were to monitor the real-time air quality in various areas across The Kingdom of Bahrain (Manama "Capital", Muharraq, Shakhurah, Isa Town, Riffa, and Sakheer), conduct a one-day analysis in a high human activity area , and demonstrate the effect of spraying water at an altitude on the concentration of particulate matter in the air.

In order to achieve these objectives, a drone system was developed from scratch and initially set up with its appropriate software to ensure basic functionality. Sensitive sensors for the concerned pollutants (particulate matter, C0, C02, N02, S02, NH3, and 03) were tested and roughly calibrated. Spraying mechanism using a 400 mL tank of distilled water was designed. Data collection and analysis based on the local thresholds were performed with the integration of a Bluetooth module that transmitted real-time data to a mobile application for display. All were integrated together using an Arduino microcontroller to create the final environmental drone system. All sensors, the spraying system, and the required electronic components of the system were safely attached to the drone platform. The total cost of developing the AeroDoctor system was approximately 150 BHD.

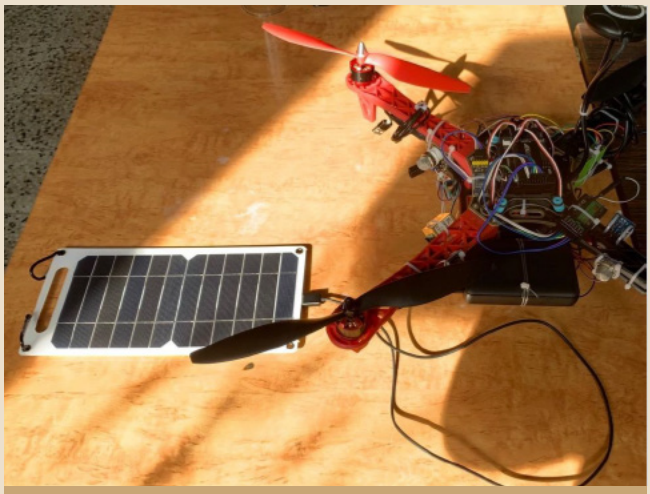
After the system was fully designed, all objectives were successfully achieved. The monitoring yielded consistent readings in several areas across Bahrain as the it was performed in a stable weather week, and a one-day analysis was performed in Isa Town to assess the air quality and observe pollution trends, as the area is densely populated due to its educational institutions and presence of numerous governmental facilities. The trends and changes of the seven pollutants were shown and explained. Finally, the spraying technology was tested on a dusty day in Isa Town where particulate matter concentrations were above the thresholds, and an average reduction of 17.21% was noticed during the next five minutes of spraying with other minor reductions in the concentrations of the other pollutants.

For future work, further modifications can be made, such as making the system work autonomously, using a more powerful industrial-grade drone that is capable of handling all the of the system components without effecting its flying function, as well as testing other scrubbing solutions that could be more beneficial and effective for the other pollutants. The long-term vision is to use multiple AeroDoctor drones in a swarm configuration to produce a significant improvement in the overall air quality across Bahrain.



Assembly and delivery

Solar panel for charging the drone's battery



Charging the portable charger using a solar panel

4

Civil Engineering

Design of Multi-Use Building with Post-Tension Slabs

Students:

Afaf Aqeel AL Showaikh

Ali Mohamed Ateya

Ahmed Jameel Ahmed

Supervisor:

Dr. Muhammad Ajmal

The project focuses on the development of a mixed-use facility located on a 28,000 square meter plot in the highly sought-after Bahrain Bay, a prominent commercial area. The design, inspired by the sea, features a stunning glass facade that makes the building an iconic landmark in the region. The facility will include three floors that house a luxury shopping mall, office spaces, and a museum with a unique aquarium measuring 9 meters in diameter and 13.5 meters in height.

The project started from scratch, beginning with the initial design and drawing the AutoCAD plans ourselves. We used various software tools to create and design the project, including AutoCAD and Revit for both 2D and 3D drawings. For structural design, we used ETABS for the overall building structure, RAM for designing the post-tension slab, and SAP for designing the aquarium. All materials used in the project were sourced from suppliers available in the Bahrain market to ensure feasibility and cost-effectiveness.

To accommodate the high demand for parking, the project includes more than 700 parking spaces within a multi-story parking structure. This ensures easy and convenient access for both visitors and tenants. Additionally, the development is well-connected with nearby road networks and public transportation, including direct bus access, making the facility easily accessible.

This project aims to create a modern and well-connected space that serves commercial, recreational, and cultural needs. The building's design and its diverse features ensure that it will become a key landmark in Bahrain Bay. By completing this project from the ground up, we have developed a comprehensive understanding of the process of designing and constructing a large-scale, multi-purpose facility, which will contribute to the continued growth and development of the region.

(Aquarium level (floor

Shop level floor

5

Mechanical Engineering

Multi-Objective Design Optimization of Coronary Stent

Students:

Abbas Fadhel Abbas

Ali Ahmed Madan

Sayed Ali Ahmed

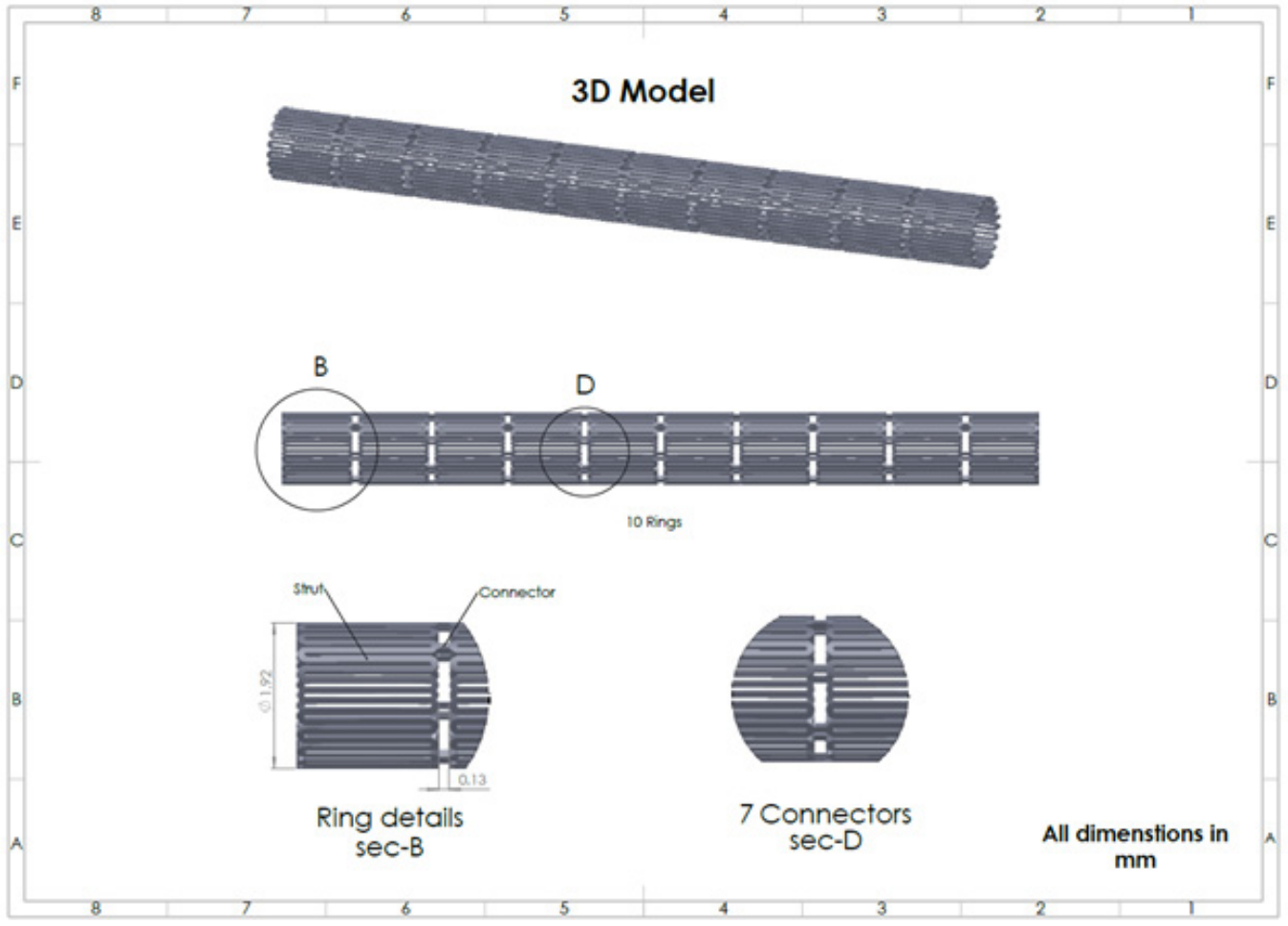
Supervisor:

Dr. Raguraman Kannan

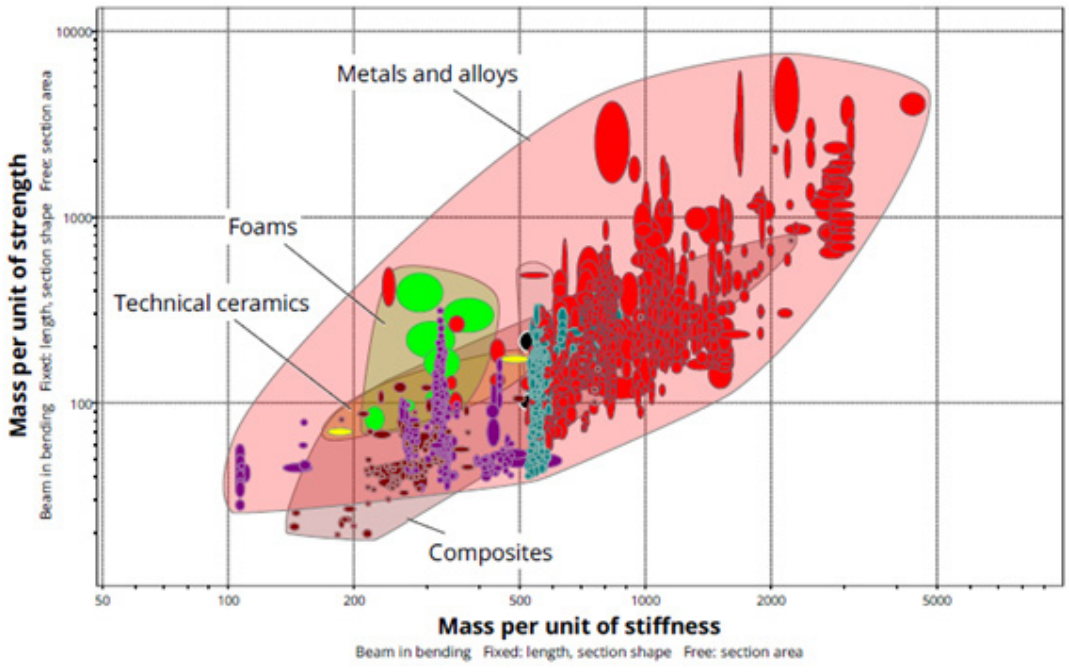
The project focused on the design, simulation, and optimization of a coronary stent tailored for treating coronary artery diseases while meeting clinical requirements. A balloon-expandable, open-cell stent design was developed using 316L stainless steel, offering a balance between flexibility and radial strength. Advanced simulation tests, including expansion, radial compression, and fatigue tests, were performed to evaluate the stent's performance under physiological conditions. The optimized design achieved a radial strength of 429 MPa, ensuring sufficient support against vessel collapse, and a fatigue usage factor of 0.458, demonstrating durability under repetitive loading.

Key performance indicators such as dogboning, foreshortening, and radial recoil were optimized within ranges consistent with clinical standards, ensuring a balance between structural integrity and adaptability. Multi-objective optimization was utilized to adjust strut width (0.07–0.09 mm) and length (1–1.8 mm), allowing for trade-offs between conflicting objectives such as strength and flexibility. The final design achieved 26.7% artery coverage when fully expanded, restoring the artery's diameter to a healthy 4 mm.

This project integrates engineering principles and medical requirements to produce high-performance stent. The outcomes highlight the potential for improving patient outcomes through meticulous design and optimization while adhering to clinical and manufacturing constraints.



3D drawing using SolidWorks software

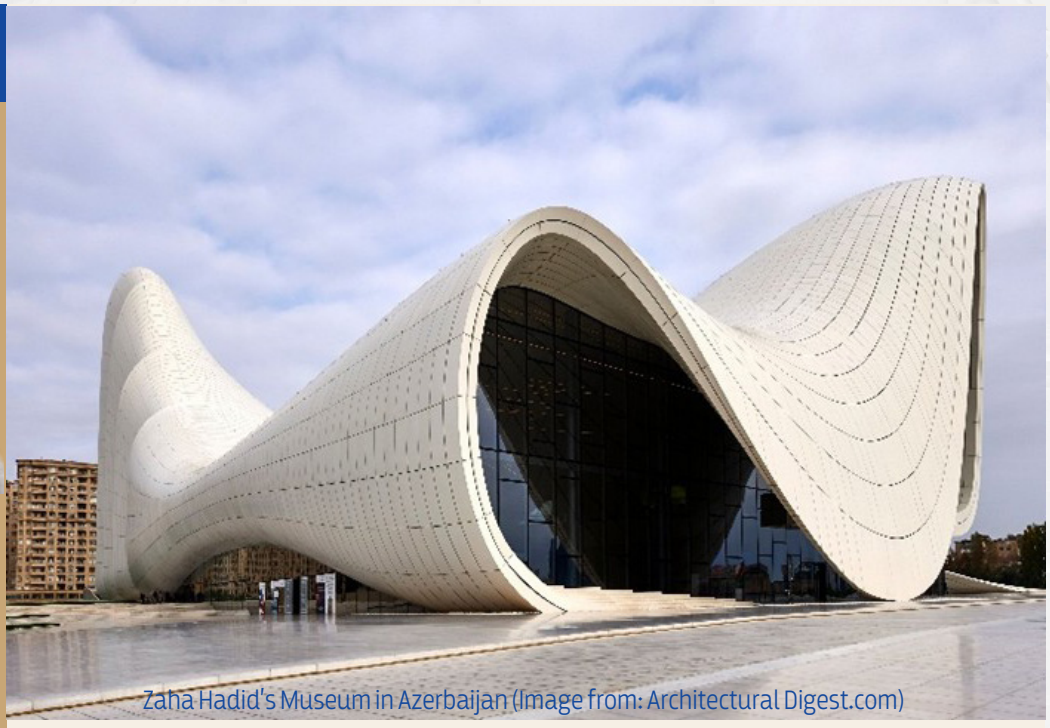


Mass per unit force versus mass per unit of stiffness

Dr. Wael Abdelhameed

Acting Vice Dean, College of Engineering, Applied Science University

Associate Professor, Department of Civil and Architectural Engineering



Zaha Hadid's Museum in Azerbaijan (Image from: Architectural Digest.com)

New Pedagogy in Architecture Education

I will begin this article with two questions: Do we need an elaborate pedagogy in architecture education to cope with the potential of new technology? Is there an existing pedagogy that needs to be updated?

Continuously emerging challenges and potentials impact the realm of architecture and all its related areas, such as practice, construction, design, and education. Researchers often investigate the overall impact of these challenges and potentials in many forms: for example, their impact on changing work and teaching environments, on altering methods of instruction, on refining the design process, and on influencing architecture itself. Moreover, many researchers and architecture professors state that there is a deficiency in elaborate methodologies that guide the integration of new challenges and potentials in the teaching and practice of architectural design.

In each area previously mentioned, there are many factors and variables that we, as instructors, should study and convey to our learners. Simultaneously, we must demonstrate their influence on design practice, the development of design capabilities, methods of thinking, the forms we create, and even visual design thinking. As one example, we should highlight the impact of newly emerging structural systems and materials. Questions such as how to use them effectively in our designs, or how to employ them to achieve sustainability, are of great importance. It is not an effective strategy to leave these areas for students to explore on their own or for graduates to integrate into their professional skills without guidance.

Taking digital media as another example, I would share the old/current status as expressed by professors such as Marx and Kellett. Marx (1998) maintains that computers have the potential to radically change the process of architectural design. He argues that instruction in architectural design should be 'creatively based' rather than 'skill based,' moving beyond the conventional concepts currently applied. Kellett (1996) describes the combination of traditional tools and techniques with novel ones as the 'messy mix.'

I would argue that architecture schools require an elaborate pedagogy and theory to deal effectively with both media.

Walt Disney Concert Hall by Frank Gehry (Image from: milimet.com)

This is an old dilemma that hinders the collaborative effort to articulate architecture pedagogy, as evidenced by the two preceding references and opinions, Figure 1. This elaborate pedagogy is necessary, particularly given the indispensable benefits of BIM, VR, digital twins, and metaverse technologies, Figure 2. These technologies may radically change not only the architecture curriculum but also how learners acquire knowledge and skills in the light of the current technologies.

The first step is to deliberately evaluate and clarify each challenge and potential, and then to examine the transformations emerging in architecture itself (e.g., built form, concepts utilized, construction techniques, etc.). The final step is to develop the design capabilities of the learners by proposing a new pedagogy for how students should be educated and prepared for design practice.

This requires collaborative work among architecture schools. The changes in areas such as work and teaching environments, methods of instruction, the design process, architecture itself, and even the role of architects must be fully explored and comprehended. The aim of this collaborative work is not only to identify the contributions and challenges but also to gain a deeper understanding of the theories and practices that align with the continuous development of trends in architecture and its related areas.

Augmented Reality and BIM in construction (Image from: itanks.eu)

b- Metaverse, AI, VR: The Future of Architecture and Design

Articles

Hani Al-Khayat

BANAGAS
Kingdom of Bahrain

Concrete Material

Introduction

Concrete is a composite material that forms the backbone of modern construction. Like other building materials, it has unique advantages, disadvantages, and properties. Its versatility and durability make it the most widely used material in construction worldwide, from residential homes to major structures like bridges and dams.

This article introduces concrete and related topics in a straightforward manner, aimed at both new and experienced civil engineers, contractors, and professionals from other fields. Future articles will address issues such as cracks in concrete structures.

Purpose of Concrete

Concrete is a versatile material in construction, valued for its workability, strength, and durability. Its adaptability allows it to serve structural, architectural, fire-proofing functions, etc.

Composition of Concrete

Concrete consists primarily of three components: cement, water, and aggregate (both fine and coarse). Additives or chemical admixtures may also be included, but are optional.

In summary: Concrete = Binding Material + Water + Aggregates + Additives (optional)

Cement: The key ingredient in concrete, cement acts as a binder when mixed with water. It forms a paste that coats and holds the aggregate together as it hardens, providing strength and durability.

Water: It hydrates cement, initiates chemical reactions with additives, and turns dry concrete mix into a workable, hardening mixture.

Aggregate: Provides structure and texture to concrete; includes fine aggregate (sand) and coarse aggregate (gravel or crushed stone).

Additives (optional): Improve concrete's workability, strength, and durability (e.g., plasticizer, silica fume).

These ingredients are key to determining concrete's properties and applications. During production and casting, factors such as composition, proportions, mixing, casting method, and curing significantly affect workability, strength, and durability.

Note: The ingredients above can be combined to create various construction materials.

Cement Paste = Cement + Water. (Used for surface finishing such as plastering, coating steel reinforcement bars prior to use, etc.).

Mortar = Cement + Water + Sand (Fine Aggregate). (Used for surface finishing such as plastering, etc. Stronger than cement paste due to the presence of sand).

Concrete = Cement + Water + Sand (Fine Aggregate) + Stone (Coarse Aggregate). (Used in construction for structural elements. The strongest due to the presence of stone).

Curing of Concrete

Curing concrete involves maintaining adequate moisture, temperature, and time to complete hydration, ensuring the material hardens properly for strength and durability. This process keeps the surface moist to prevent cracking from moisture loss and helps achieve maximum compressive strength, durability, and reduced shrinkage. Curing also protects against environmental effects like sun, wind, and frost, which can weaken concrete. The minimum recommended curing period is seven days of continuous moisture after hardening. While water-based methods (such as wet covers with hessian and plastic sheets) are preferred especially in hot climates, curing compounds can be used where water is impractical.

Types of Concrete

Concrete is widely used in construction because of its versatile applications, cost-effectiveness, and beneficial properties. It is used in residential, commercial, mid-rise, and high-rise buildings, as well as roads, floors, basements, dams, etc. Below are several key types of concrete:

Reinforced concrete (R/C) or reinforced cement concrete (RCC): Widely used worldwide, this type embeds steel bars

or mesh to increase tensile strength and durability. It is commonly applied to foundations, beams, columns, and retaining walls.

High-Strength Concrete: Stronger than regular concrete, with compressive strength over 55 MPa. Used in large projects like tall buildings, dams, and bridges where extra strength is needed.

Ordinary Concrete: Commonly used in areas where high tensile strength is not required, like pavement and walkways.

Lightweight Concrete: This concrete weighs less than regular concrete, with a density of about 1900–1920 kg/m . It is used for paving blocks and protecting steel structures.

Precast Concrete: Manufactured in a plant and delivered for onsite installation, precast concrete is often used for columns, beams, staircases, wall panels, and slabs. It offers faster construction and higher quality due to controlled production conditions.

High-Performance Concrete: This concrete offer superior durability, strength, density, low porosity, and high temperature resistance compared to standard concrete. It is used in specialized projects like nuclear power plants and offshore structures.

Self-Consolidated Concrete: This concrete compacts under its own weight without manual vibration and is highly workable, earning it the name "flowing concrete."

Although there are many types of concrete, it is mentioned only the most used and well-known ones for simplicity and to help non-civil engineers understand. Concrete is essential

for construction projects like buildings, roads, and bridges, but selecting the right type matters. Clients and engineers should rely on knowledge, experience, and judgment to choose the best concrete for each situation and maximize its benefits.

Properties of Concrete

Concrete's properties make it a preferred material in construction with many applications. Key properties include:-

Workability: This term refers to how easily fresh concrete can be placed, compacted, and finished. It is essential for shaping and allowing the mix to surround steel reinforcement. Key factors affecting workability include water-cement ratio, aggregate size and shape, grading, admixtures, and mixing methods.

The slump test is the most common way to measure concrete workability on site. Good workability allows for easy handling, consistent strength, and improved durability.

Strength: This term refers to the loads and stresses concrete can handle. Concrete excels in compressive strength but is weak in tensile strength, with compressive strength varying by composition and curing time.

Strength determines the durability and integrity of structural elements like foundations, beams, and columns. It depends on water-cement ratio, curing, aggregates, mix proportions, compaction, workmanship, and age. The concrete cube test is a common method to measure strength.

Shrinkage: This term refers to the reduction in concrete volume as it hardens and dries, which can cause cracks and weaken durability. Types of shrinkage include plastic and thermal, and factors influencing it are water-cement ratio, curing, aggregates, mix proportions, and environment.

To minimize shrinkage, use proper curing to retain moisture, adequate steel reinforcement, lower water-cement ratios while maintaining workability, shrinkage-reducing admixtures, well-graded aggregates, and expansion joints for large structures. Shrinkage cracks may not directly affect strength but can reduce durability and impact appearance.

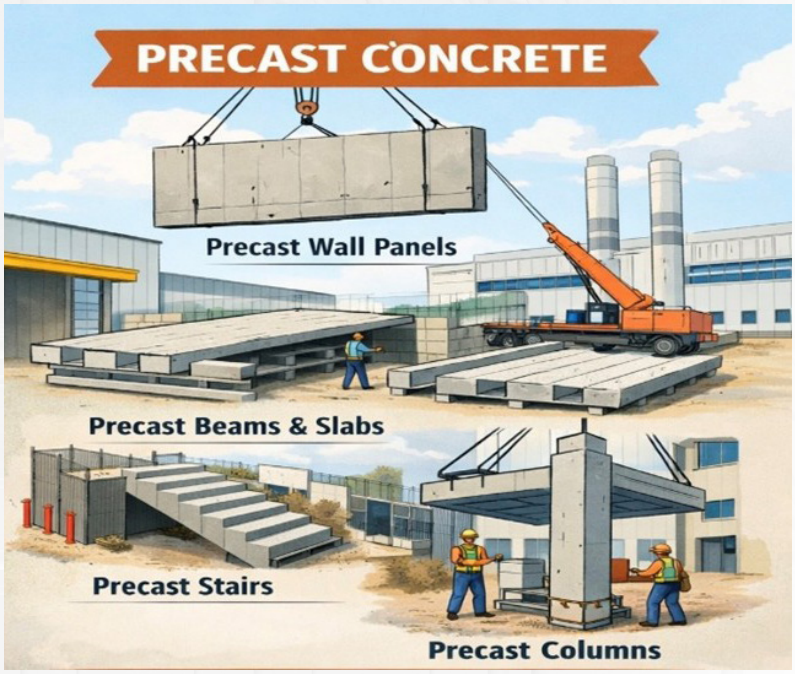
Creep: This term refers to the gradual deformation of concrete under continuous load, influenced by factors like high water-cement ratio, temperature, humidity, poor curing, and low-quality aggregates. It occurs as basic creep or dry creep and can lead to beam/slab deflection, cracking, prestress loss, and instability.

To reduce creep, use a lower water-cement ratio (with maintained workability), ensure proper curing, minimize sustained loads, apply adequate reinforcement, and select high-quality, well-graded aggregates. Effective mix design and these measures support durability.

Durability: This refers to the concrete's ability to resist environmental factors (like water, humidity, wind, and temperature) and service demands without significant damage over time. It depends on factors like water-cement ratio (lowering it improves durability by reducing permeability while maintaining workability), curing, environment, admixtures, aggregate quality, mix design, and permeability.

Concrete can deteriorate due to steel corrosion, freeze-thaw cycles, chemical attacks, abrasion, erosion, and reactions such as Alkali-Silica Reaction. To enhance durability: use

proper curing, low-permeability mixes, anti-rust coatings, air-entrainment for freeze-thaw areas, good compaction, waterproof and protective coatings, along with regular inspection and maintenance. Durable concrete increases structural lifespan, lowers repair costs, and improves safety of the structure.



Modular Ratio: This term refers to the modular ratio is the ratio of steel's modulus of elasticity (ES) to that of concrete (EC), representing how steel and concrete combine in reinforced concrete, with steel handling tension and concrete handling compression.

The formula is (m = ES/EC), where (m) is the modular ratio and (E) is Young's modulus. Since concrete comes in different grades, the modular ratio varies; accordingly, a higher modular ratio generally means stronger and more durable structures.

Unit Weight: This term refers to concrete density, which depends on its type and composition; higher unit weight means stronger and more durable concrete.

Typical unit weights: plain cement concrete is 2300–2500 Kg/m , reinforced cement concrete is 2400–2600 Kg/m , lightweight concrete is 300–1800 Kg/m , and heavyweight concrete is 3000–5000 Kg/m . Unit weight or density is given in Kg/m or KN/m .

Poisson's Ratio: This term refers to describing the response of a material to stress. Poisson's ratio can be defined as the negative ratio of lateral strain to longitudinal strain. For most of the materials, Poisson's ratio is positive, ranging between 0 – 0.5, noting that it is unitless.

V= -(Lateral Strain ÷ Longitudinal Strain)

Poisson's ratio helps engineers understand how materials will behave under different stresses or forces.

Longitudinal Strain: Deformation in the direction of the applied load or stress.

Lateral Strain: Deformation perpendicular to the load or stress.

The negative sign indicates that lateral strain occurs in the opposite direction to longitudinal strain.

When a material is stretched, it becomes longer and thinner, and conversely, when it is compressed, it becomes shorter and wider.

Most materials have Poisson's ratio (positive) between 0 < V 0.5. These materials will contract in lateral direction when tensile force is applied. Isotropic material, value is not exceeding (0.5).

Materials with a Poisson's ratio of zero, when longitudinal tensile force is applied, there will be no deformation in the lateral direction.

Materials (known as auxetic materials) have Poisson's ratio (negative) between -1 V < 0, they expand laterally when pulled and contract laterally when compressed.

Concrete and steel are our focus materials. Concrete typically has a value between (0.1 – 0.2), while steel ranges between (0.27 – 0.3).

Uses of Concrete

Concrete is a key construction material with diverse applications, used in projects of all sizes. Its popularity stems from its versatility, strength, and durability.

Additionally, concrete has several characteristics that make it highly sought after in the construction industry.

Concrete can be tailored with various characteristics and types to meet specific design and application requirements.

It is less dynamic than structures built with materials like steel, timber, or others.

It offers added value by protecting end users from external elements and providing superior structural integrity during earthquakes compared to other building materials.

It resists fire.

It withstands heavy loads when reinforced with steel bars.

Its workability allows it to be molded into various structural and architectural forms.

Below are the main uses of concrete in daily life:-

Residential, commercial and parking buildings.

Roads, streets and pavements.

Flyovers and bridges.

Marine structures.

Culverts, sewers and underground chambers.

Structural elements such as foundations, beams, columns, retaining walls, etc.

Architectural structures and shapes.

Tunnels and dams.

Boundary walls and fences.

Advantages and Disadvantages of Concrete

Advantages of concrete:-

High compressive strength: supports heavy loads for versatile applications.

Fire resistant: Noncombustible and withstands high temperatures.

Maintenance Cost: Needs little upkeep, so costs are lower than with other materials.

Durability: It withstands severe weather and is fire resistant, making it suitable for long-term use.

Versatility: Its liquid form allows shaping for complex architectural and structural designs and various applications.

Economical: Cost-effective due to readily available raw materials or ingredients.

Environmentally Friendly: Lowers environmental impact by using waste materials like fly ash and slag in concrete.

Water Resistance: Can be made impermeable, suitable for dams and water tanks.

Generating Different Types: Creating specific types of concrete based on needs and requirements.

Disadvantages of concrete: -

Low Tensile Strength: Concrete has low tensile strength and needs steel reinforcement to resist tension; otherwise, it is brittle and prone to cracking.

Heavy Weight: Its high weight and density complicate transport and often requires additional support before casting.

Weather Sensitivity: Prone to cracking from heat, cold, freezing temperatures, direct sunlight, or wind.

Environmental impact: While concrete is generally considered environmentally friendly, cement production generates C02.

Shrinkage and cracks: May occur even with proper curing.

Long Curing Period: Achieving full strength after setting can take from 7 to 28 days, depending on the case.

Limitation in Reshaping: Cannot be reshaped like steel after setting.

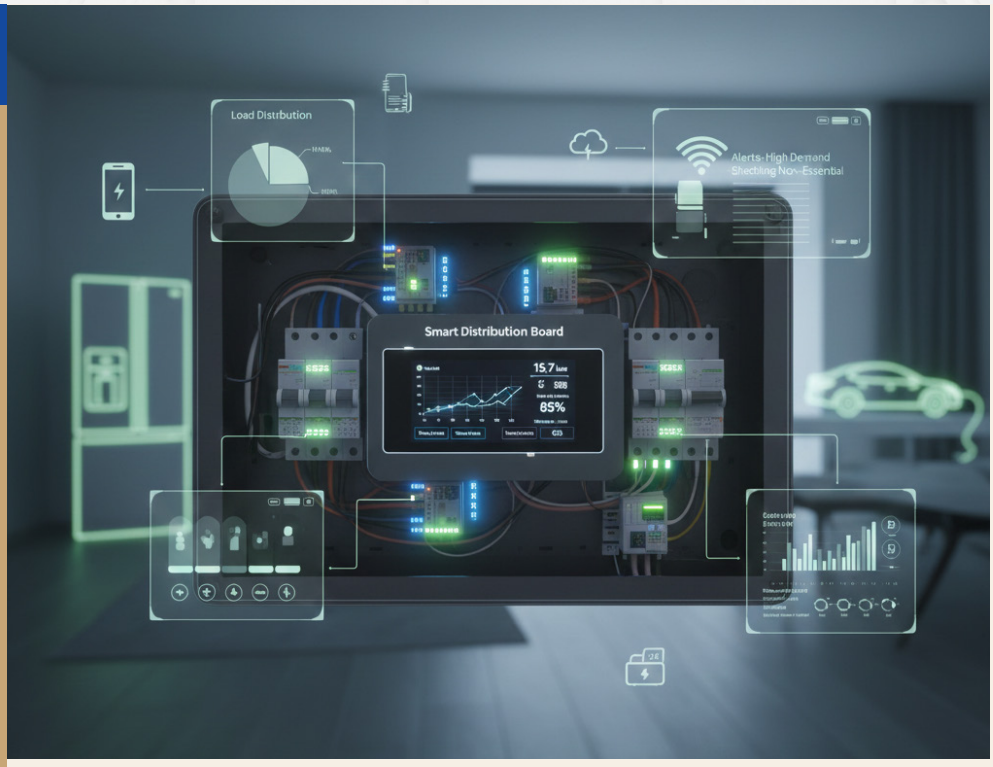
Conclusion

Concrete has revolutionized construction industry due to its versatile properties and applications, especially with innovations like reinforced, pre-stressed, and precast concrete. It serves as the foundation for most projects, from buildings and bridges to pavements. Choosing the right type of concrete is essential for each project. Despite its drawbacks, concrete remains crucial in construction industry, and greater knowledge helps us mitigate its limitations.

Projects

Students:
1. Abdulla Mohamed Alheddi
2. Mohamed Ebrahim Alalawi
3. Sultan Salem Alzaed

Supervisor:
Dr. Maamar Taleb
Electrical & Electronics Engineering Department
University of Bahrain



Smart Distribution Board with IOT-based Load Management, Monitoring, and Shedding

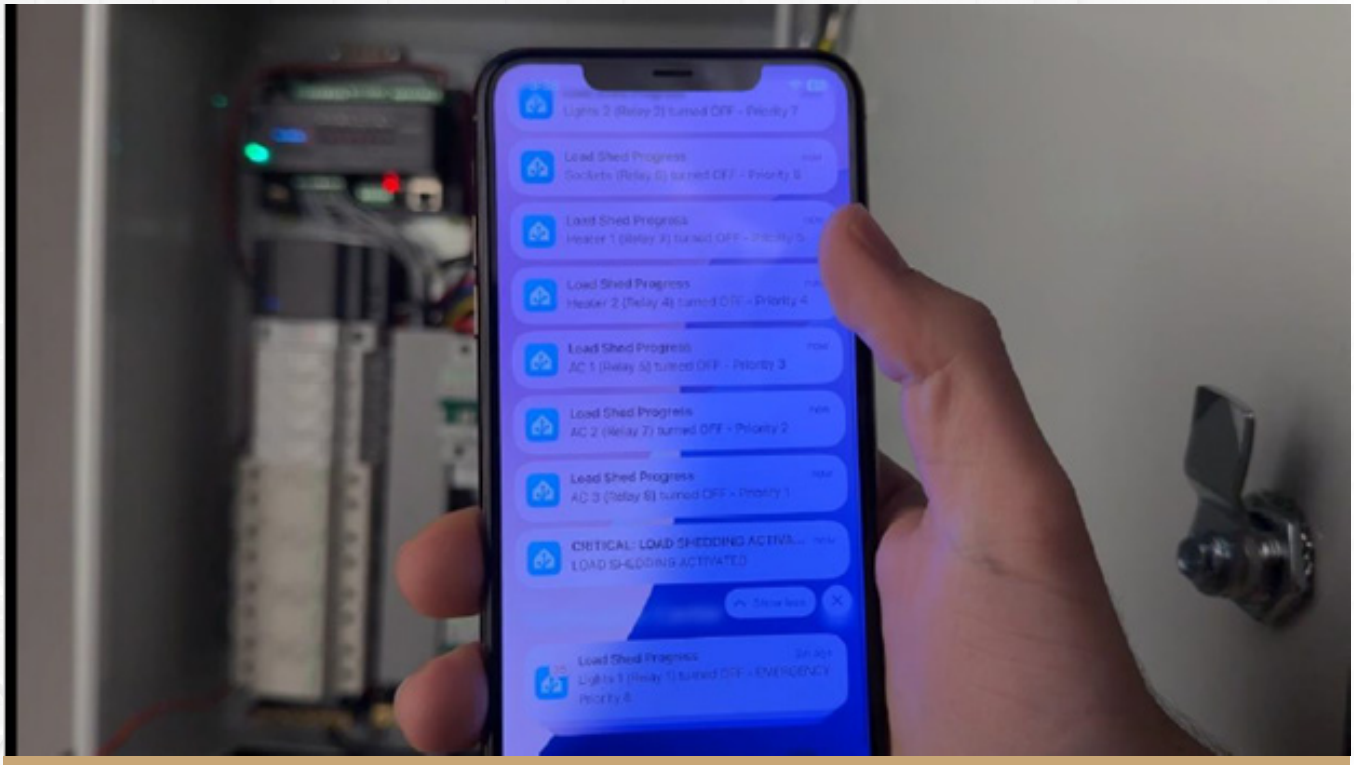
The project presents the design, development, and validation of a smart distribution board intended to overcome key limitations of conventional residential panels, which typically lack real-time monitoring, load prioritization, and remote control. The proposed system integrates a custom three-phase power-metering PCB based on PZEM-004T modules, an ESP32-based KinCony B8 controller for actuation, and an IoT communication layer using the MQTT protocol. Measured electrical parameters are transmitted to a locally hosted Home Assistant server, which aggregates the data, applies configurable control logic, and provides a dashboard for real-time monitoring and manual control of individual loads.

The system implements a priority-based load-shedding algorithm that disconnects non-critical loads when consumption exceeds thresholds, enhancing electrical safety, supporting essential circuits, and reducing the risk of overloading. Particular attention is given to the selection and sizing of electrical components, including contactors, MCBs, residual current devices, and cables. Ratings are determined according to expected load currents, diversity and derating factors, and prospective fault levels, ensuring compliance with IEC standards and Bahrain's Electricity Distribution Directorate regulations.

From a hardware perspective, the PCB layout is designed with galvanic isolation, creepage and clearance distances, suitable trace sizing, and segregation between high- and low-voltage domains. The prototype was assembled and tested in the laboratory, and its measurements were compared

with reference instruments to validate accuracy under different loading scenarios. Experimental results confirm proper three-phase power measurement, stable communication, and reliable operation of the load-shedding algorithm. The proposed smart distribution board offers a practical solution for improving energy visibility, electrical safety, and integration with smart-home platforms, while also providing a basis for enhancements such as analytics, demand response, and energy storage integration.

لوحة التوزيع الكهربائي في حالة التشغيل



طريقة تفعيل إشعارات فصل الأحمال

Projects

Students:
Sara Saeed Ali Ahmed
Ahmed Abdulfatah
Mohsen Almahari
Manar Mahdi Jawad
Jassim

Supervisor:
Dr. Fadhel Abbas Al-Basri
Department of Electrical
& Electronics Engineering
University of Bahrain

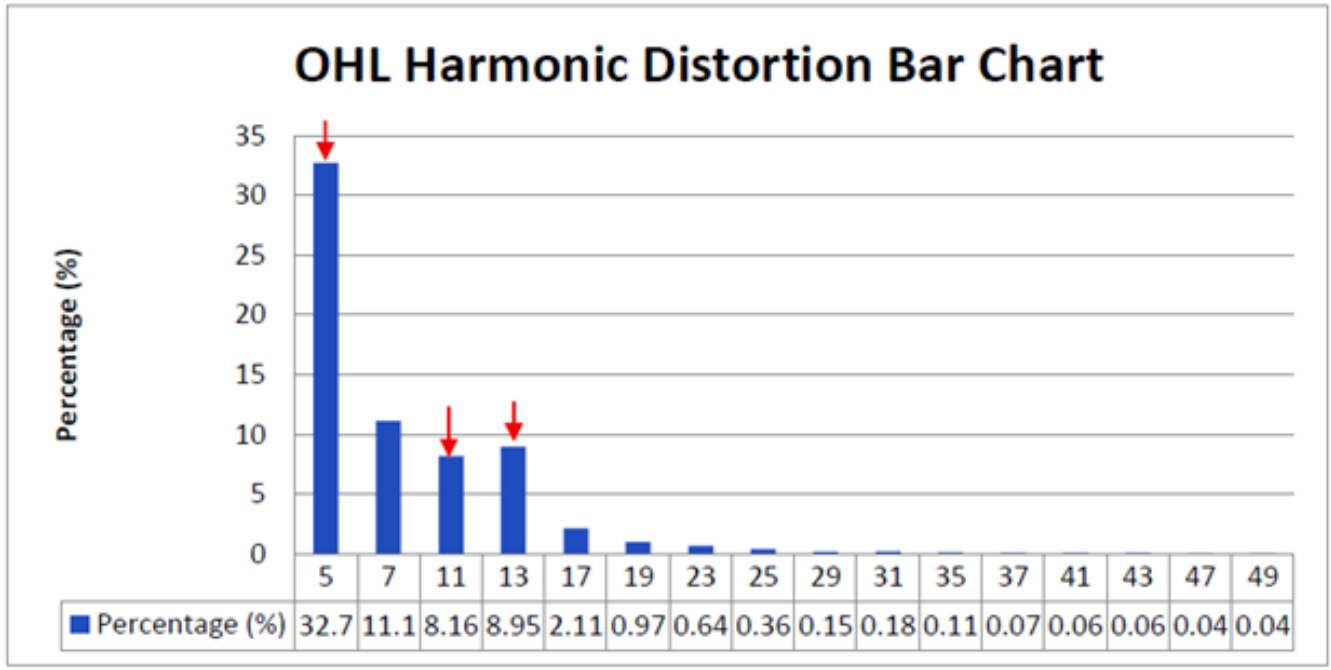
Harmonic Analysis of Industrial Systems

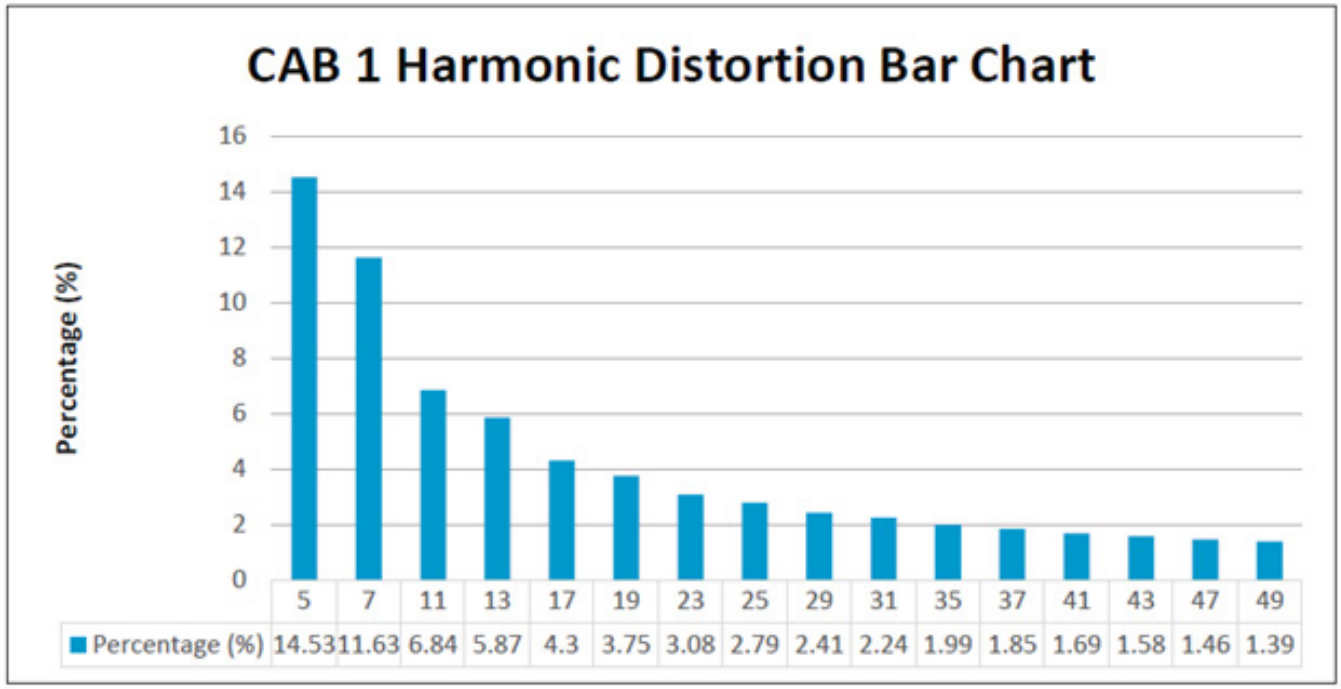
In many industrial facilities, unexpected issues such as capacitor bank failures, motor overheating and differences between measured and billed energy consumption, can occur even when the system appears to be operating within its nominal limits. These problems often lead engineers to focus on routine equipment maintenance without approaching it by a study of the underlying causes. However, once conventional factors are ruled out, these scenarios are frequently traced back to poor power quality conditions within the network.

This study aims to investigate the impact of elevated harmonic distortion on power system equipment and evaluate how it affects overall harmonic propagation in the system and introduce limits of operation for elements, excluding some for future work due to lack of real data.

The harmonic behavior of the network was evaluated using DIgSILENT Power Factory for system-level modeling and MATLAB/Simulink for harmonic spectrum analysis. Different cases with varied harmonic sources, loading conditions, and system impedances were simulated to analyze harmonic indices (THDi) and ( ) and the relation of short-circuit MVA to elevated violations of and according to IEEE 519 standard. Harmonic Working Group Task Force provided benchmark system appendices to compare against simulation results to ensure alignment with expected results.

Ensuring successful approach, harmonic filters were designed and tested through simulation. The proposed filter solutions demonstrated improvement in power quality and helped the system meet the IEEE 519 limits. Although the study faced limitations such as limited access to real industrial data and simulation constraints, the findings provide useful recommendations for improving harmonic performance in industrial networks in Bahrain.



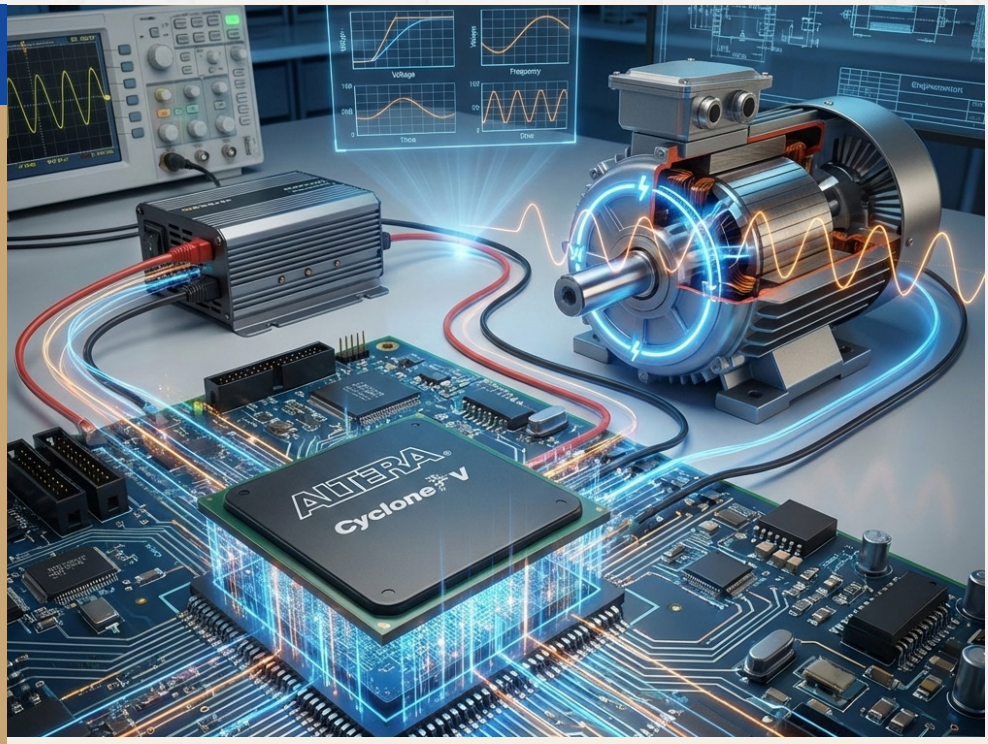


تشـوه توافـقي للـكـابل الأول

Projects

Students:
Aalaa Firas Sowid Ibrahim
Amin Mohamed Isa Thamer
Mohamed Jaafar Jasim

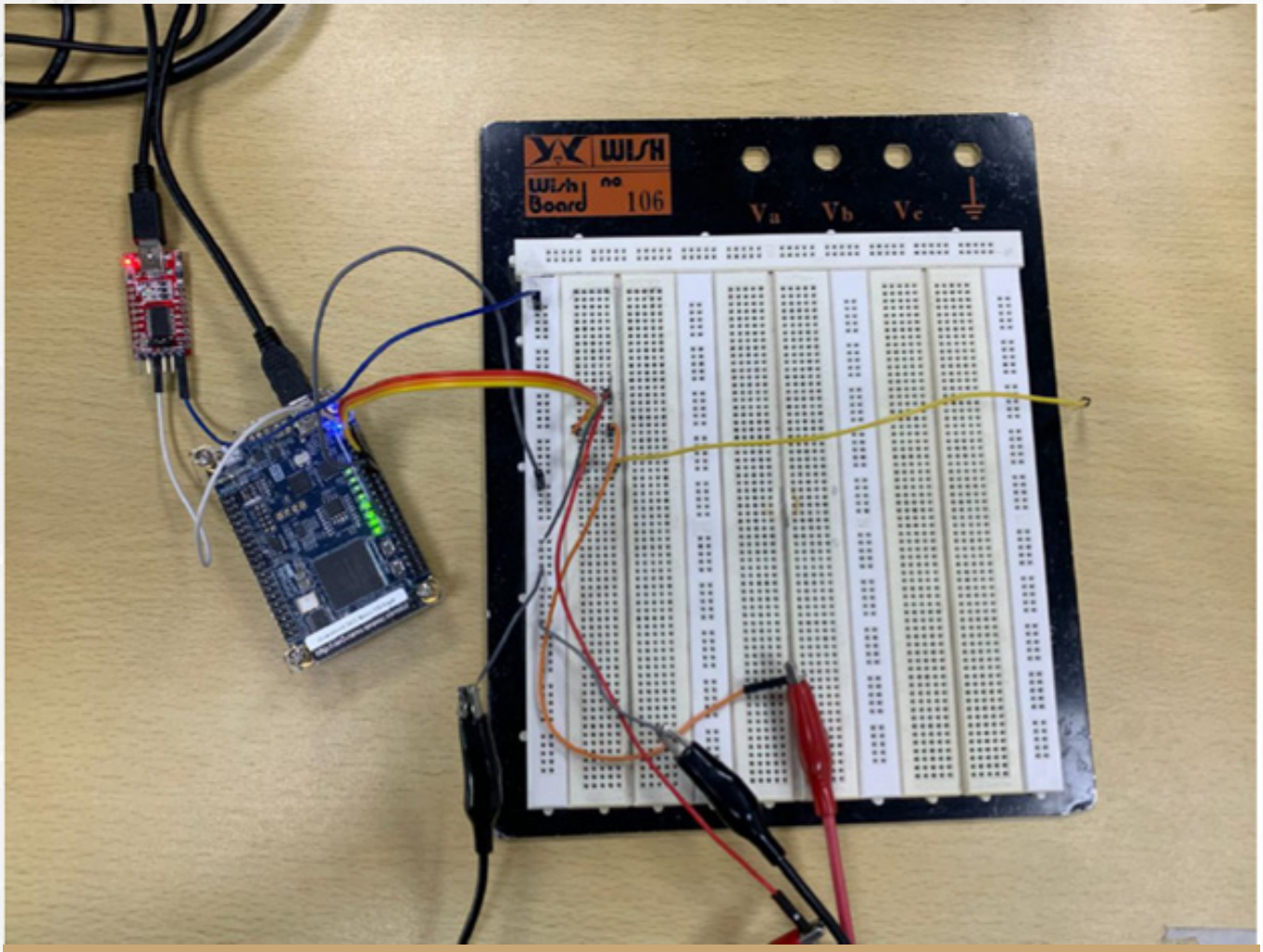
Supervisor:
Dr. Mohamed Amine Fnaiech
Department of Electrical & Electronics Engineering
University of Bahrain



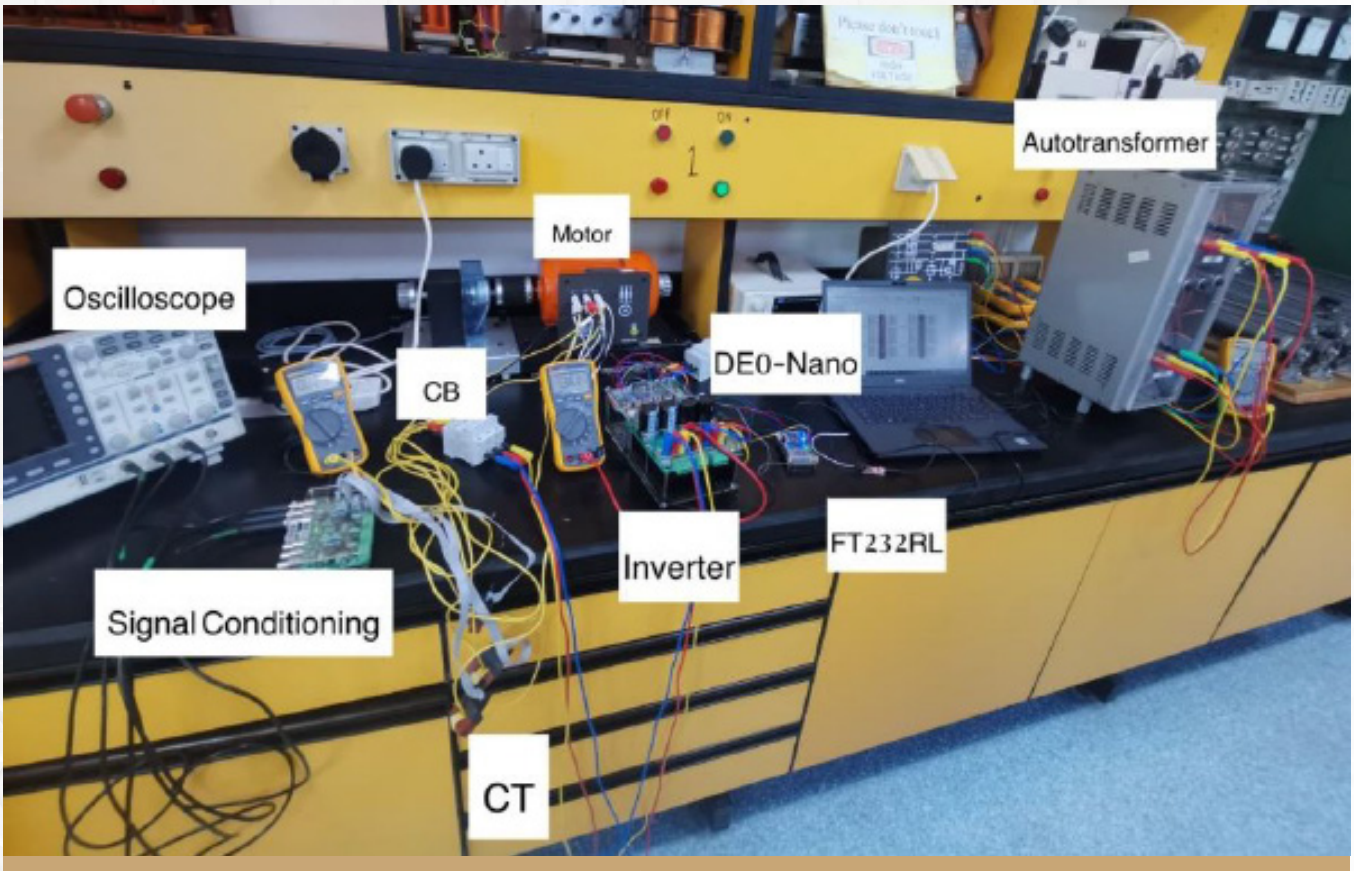
Voltage to Frequency Control of Induction Machine using Field-Programmable Gate Array Altera

The project presents an FPGA-based constant voltage-to-frequency (V/f) control system for three-phase induction motors using the Altera DE0-Nano development board. The V/f control technique maintains a constant voltage-to-frequency ratio to preserve optimal motor flux and torque characteristics across the operating range. The complete control algorithm was developed in Verilog HDL using Quartus Prime Lite, generating sinusoidal PWM signals with programmable dead-time insertion for inverter protection and featuring UART communication for real-time speed control with ramping to avoid damaging the motor.

Simulation and experimental testing validated accurate V/f ratio maintenance, precise speed control, and stable motor operation across multiple speed references. The key achievement is demonstrating that low-cost FPGA platforms integrated with low-cost UART modules can deliver professional-grade motor control with real-time responsiveness, implementation flexibility, and reliable operation. A significant advantage is the direct Verilog HDL implementation, which avoids platform-limited tools like Simulink that do not support all boards and increase system complexity and cost, a distinction from most similar projects. The system's modular architecture and parametric design establish FPGA technology as a viable, economical alternative to traditional DSP-based or high-range-FPGA-Based drives.



DE0-Nano و FT232RL في المختبر



إعداد الإختبار

Projects

Students:
Hasan Reyadh Isa
Mohammed Ali
Mohammed

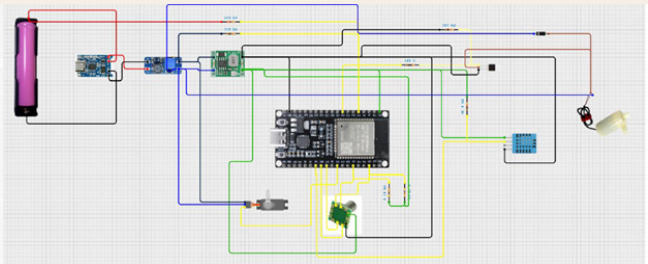
Supervisor:
Dr. Mohammed Majid AL-Khalidy
Department of Electrical & electronics Engineering
University of Bahrain

Smart Automated Drug Injection System

Automated drug delivery systems have gained significant importance in modern healthcare due to the increasing demand for precise dosage control, patient safety, and reduction of human error during medication administration. This project presents the design and implementation of a smart injection system intended to automatically deliver controlled doses of liquid medication using an embedded electronic control platform.

The system integrates a programmable microcontroller, sensing, to achieve accurate drug infusion through smart control strategy. A pressure sensing is employed to continuously monitor the drug delivery line to detect abnormal conditions such as occlusion or leakage, while a temperature and humidity sensor ensures that environmental conditions remain within safe operational limits.

A miniature brushless direct current pump is utilized to control the fluid flow rate, and a servo motor is responsible for inserting and retracting the needle in a controlled and repeatable manner. The system is powered by a rechargeable Lithium-ion battery, supported by dedicated charging and power management circuits to ensure safe operation and sufficient runtime. Software algorithms were developed to manage system, dose configuration, injection sequencing, real-time monitoring, emergency shutdown procedures, and data logging. The system allows healthcare personnel to configure dosage parameters such as volume, flow rate,



The complete electrical circuit diagram for the automated smart drug injection system, designed using Cirkit Designer, shows the power management unit, ESP32 controller, sensor interfaces, MOSFET-based pump actuator, and servo drive circuit.

number of daily doses, and time intervals between doses, after which the injection process operates autonomously. The proposed design was implemented and verified using a breadboard-based prototype to validate electrical connections, control logic, and sensor integration prior to final hardware realization. Experimental evaluation demonstrated that the system could deliver accurate doses while reliably detecting fault conditions and responding safely by stopping the infusion and retracting the needle. The project emphasizes system safety, reliability, and modularity, with consideration given to applicable medical device design principles and risk mitigation practices.

The outcome provides a functional proof of concept smart injection platform and establishes a solid foundation for future work aimed at miniaturization, clinical validation, and compliance with advanced medical device standards.