



Al-Munther Satellite

A Milestone in Bahrain's National Space Capabilities

A Journey with Engineer Laila Janahi

■ “I became the first Bahraini female engineer to work in the oil fields, and I act as the doctor for the oil wells”.

■ “Being granted lifetime membership by the Bahrain Society of Engineers played a significant role in shaping my professional identity”.



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A Journey with Engineer Laila Janahi

The Bahrain Society of Engineers has made tangible contributions to developing the engineering sector and enhancing professional development pathways in the Kingdom of Bahrain.



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Message from the Editor-in-Chieff



**Professor
Isa Salman Qamber**

ALMOHANDIS

Al-Mohandis magazine is largely concerned with the story of an engineer who works in the sector of the petroleum and gas sector. It thus begins with a true story of an engineer's experience in the sector along with engineering articles that focus on the vision of BSE. The magazine also places a lot of emphasis on the successfully developed satellite referred to as "Al-Munther," which relies on AI in analyzing images.

In this issue of Al-Mohandis magazine, we feature a remarkable professional who has made significant contributions to the industrial sector, particularly in oil and gas. Our guest began her career nearly thirty-six years ago as a technician in the Petroleum Engineering Department at Bahrain National Oil Company (then Banoco) and steadily advanced to the role of Manager. Our guest is Engineer Layla Janahi.

On the 15th of March 2025, Bahrain successfully launched its first domestically developed satellite, "Al-Munther," aboard a Falcon 9 rocket from Vandenberg Space Force Base in the USA. The satellite, which incorporates AI for image analysis, aims to localize satellite technology, advance Bahraini expertise, and enhance space infrastructure in the Kingdom. Its successful launch marks Bahrain's formal entry into the space sector, reflecting national capability, investment in youth, and ambitions for future satellite projects.

It is well known that the BSE 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. Five awarded projects in different engineering fields summarized in the present issue. The first project proposes an innovation and learning Centre. The Centre integrates sustainable passive design and renewable energy solutions to enhance efficiency, environmental performance, and specialized laboratory functionality. The second project implemented and compared five control strategies

for an Artificial Pancreas using the validated Hovorka glucose-insulin model under hypoglycemia, hyperglycemia, and meal disturbances. The third project details the structural design and analysis of a 28-story rotating mixed-use high-rise in Manama, addressing dynamic loads through an efficient cantilever system in compliance with the American Concrete Institute (ACI) Code for reinforced concrete structures. The fourth project designs and validates an intelligent off-grid solar PV system that ensures uninterrupted power for critical loads using real-time simulation and data-driven control.

By leveraging live and forecasted weather data for predictive load shedding, the system outperforms conventional approaches while supporting sustainable and reliable clean energy access. The fifth project develops a solar-powered autonomous oil skimmer boat that uses real-time vision-based detection and IoT monitoring to efficiently recover surface oil spills. With over 85% detection accuracy, off-grid operation, and scalable design, it offers a sustainable and cost-effective solution aligned with multiple UN Sustainable Development Goals.

Engineer Ahmed Al-Wahsoosh in his article in Arabic focuses on the application of Artificial Intelligence in the context of metal corrosion, and he considers it to be more than just a method in the fight against metal corrosion, but it is now an important partner in the way in which the challenges of metal corrosion are addressed. From the early stages of identification to the successful application in the prevention of metal corrosion and the achievement of successful returns on investment and unprecedented results in the field of effectiveness, Artificial Intelligence holds the key to many comprehensive solutions in taking the industrial sectors to a safe and more-profitable future.

The article by Dr. Wael Abdelhameed, in Arabic and English, tackles the issue of digitization, a crucial means to preserve heritage, while the utilization of Virtual Reality (VR), though very promising in delivering an immersive and realistic sensation, has remained under-explored in recording such a rich architectural heritage. The article will fill this matter by referring to a study on the means of 3D digitization and designing a new concept in the use of VR, through a micro-simulation feature, in recording and archiving the various temporal phases of archaeological sites.

With the increasing trend in embracing green energy, it has been observed that renewable energy integrated as smart and reliable solutions. Hence, it is necessary to deal with the distinct challenges posed by renewable energy sources like solar energy and wind energy. Moreover, one “exciting and promising innovation which may be taken into consideration is” FPV “- Floating Photovoltaic Power Stations.” This is a major breakthrough, particularly in countries where land is less in supply but natural resources are in ample quantity. FPVs provide space solutions when they increase “the efficiency levels at which sunlight is converted to electricity.” This article has been penned down by Dr. Fawzi ALJowder.

Next, four graduate projects at the university level are summarized. For the first project, an intelligent solar panel cleaning system is proposed, which identifies the underperforming solar panels using the voltage measurement and focuses only on the dirty ones. By leveraging a mobile robot cleaning approach selectively and reactively, the system ensures maximum energy efficiency and simultaneously reduces the costs of water, labor, and operations. In the second project, a low-cost

and automated water-cooling method is created, using sensor control, to ensure safe temperatures of the water in hot climates in an energy- and human-effort-less manner. Efficiency, scalability, and effectiveness of the method have been ascertained by testing, which indicates the method’s potential in the domestic and small-scale industrial sectors, to be later IoT and solar-integrated. In the third project, AgriTech-Rover, an autonomous vehicle is designed, which makes use of AI-driven computer visions and IoT, to identify the crops and apply pesticide to the required locations only. The effect of the pesticide will be reduced, and the health hazards associated will decrease, as the pesticide will be applied at the pointed locations only, resulting in efficient and healthier agriculture. In the final project, a real-time speed alert system using Global Positioning System (GPS), Internet of Things (IoT), and ESP32 technology. ESP32 technology refers to a low-cost, low-power, highly integrated System-on-Chip (SoC) microcontrollers. This system can sense the speed limits dynamically and notify the driver accordingly. The result of the experiment proved the correctness of the speed sensing notification.



A Journey with an Engineer

Laila Janahi

- "I became the first Bahraini woman to work in the oil sector".
- "Bahrain Society of Engineers and giving me the opportunity that greatly contributed to developing my engineering personality".

"In this issue of Al-Muhandis magazine, we host a figure who has distinguished herself in the industrial field—particularly in the oil and gas sector. Our guest has risen through the professional ranks since her appointment as a technician in the Petroleum Engineering Department at Bahrain National Oil Company (Bapco Banoco at the time) nearly thirty-six years ago, until she reached the position of Director Manager. Engineer Layla Janahi, welcome as an esteemed guest in the 84th issue of Al-Muhandis magazine."

To begin, the readers of Al-Muhandis would like a brief introduction to Engineer Layla Janahi's early life and education.

"I am the eldest daughter in a family of six children, four of whom are boys. Fate had it that I lived with my father and my brothers after his separation from my mother when I was twelve years old. At that young age, I had to shoulder great responsibility in raising my brothers and taking care of them.

Of course, a father's upbringing differs from that of a mother—it is often marked by firmness and strictness and imposes more rules and restrictions that children must adhere to. This upbringing

and home environment had a major impact on my personality. I took on responsibility at an early age and learned self-reliance, discipline, and commitment to fulfilling my duties, as well as seriousness in my studies and work—even adopting a degree of strictness, if not toughness, in dealing with others."

What made you choose engineering, and chemical engineering specifically?

"I did not choose engineering—engineering chose me. My passion for science began in childhood, and it was always my dream to specialize in this field, particularly in biology, a subject I greatly enjoyed studying. I even still keep my grade book for that



Attending the ADIPEC conference.

class, out of appreciation for the teacher I loved very much.

After obtaining my high school diploma, I applied to the College of Science to study biology and to the Gulf College of Technology to study engineering. I was accepted to both institutions, but I was more drawn to the title 'engineer,' so I chose engineering—and specifically chemical engineering—because of my great love for chemistry. Later, I discovered that there is no direct link between chemistry and chemical engineering; the former deals with understanding chemical composition, properties, and reactions, while the latter focuses on designing and operating industrial plants.

After joining the Gulf College of Technology and earning my diploma, I began my career at Bahrain National Oil Company (Bapco Banoco) as a technician in the Petroleum Engineering Department. I worked

in that position for four years, during which I gained extensive experience through daily, direct interaction with engineers and workers in the Bahrain oil field, as well as through frequent field visits and familiarization with wells and oil facilities. During this period, I witnessed significant development in both my academic and professional journey.

I suggested to my supervisor that I continue my studies to obtain a bachelor's degree in chemical engineering, and he agreed on the condition that I would not neglect my job duties. I accepted the challenge and pursued my studies for two and a half years—even while working and taking care of two children. Thanks to God, I graduated with distinction despite the difficult circumstances, and I was transferred within the same department from technician to trainee engineer. I was then gradually promoted until I became the first Bahraini woman to work in the oil field. I continued in that role for twenty



Service Rewards Ceremony at Bahrain National Oil Company (BNOCO) in 1999.

years before being transferred to the Health, Safety, and Environment Department as an Environmental Coordinator after obtaining my master's degree in Environment and Sustainable Development.

I was subsequently promoted to Director Manager of Environmental and Social Governance (ESG) until my recent retirement, after which I began my own work as an environmental consultant for an American company."

Was Engineer Layla Janahi influenced during her career by any engineering figure who helped shape her path?

"The desire to continue my studies and obtain a bachelor's degree was always on my mind. Fortunately, the work environment in the Petroleum Engineering Department at the company was very encouraging when it came to development and academic achievement—especially my direct supervisors at the time. They allowed me to attend lectures and keep up with academic requirements

without compromising my daily work duties.

This coincided with the unjust Iraqi invasion of Kuwait in 1990, which led to the return of Bahraini students who had been studying there. As a result, the opportunity was opened for us to complete our studies in chemical engineering to obtain a bachelor's degree. Since I already held an associate diploma in the field, I joined the students after the second year, despite being a mother of two children—one two and a half years old, and the other six months old—while also working.

Thanks to God, I succeeded in overcoming all challenges and completed my studies with distinction, fulfilling the trust my direct supervisor had placed in me and my abilities."

You are considered the first Bahraini woman engineer to work in Bahrain's oil fields. How would you describe to the readers of Al-Muhandis the work environment of that time and the reaction of those around you, as a



At the work site in Indonesia.

woman entering a profession that was then seen as exclusively male?

“After obtaining my bachelor’s degree, I moved on to work as a trainee engineer and was gradually promoted until I became the first Bahraini woman to work in the oil sector. My role involved monitoring oil well production and working continuously to maintain and maximize output, which required being present in the field and closely following up on the wells.

Women working in the oil field until the mid 1990s during the 1980s in Bahrain was neither normal nor widely accepted, as society was predominantly male-oriented. Being a veiled woman—alone among men—was a major challenge, especially since my small physical build made the job even harder. For example, I used to drive a pickup truck by myself to well-maintenance drilling platforms and perform what we considered the role of a doctor to the oil well, which we treated as a patient requiring great

effort to restore to peak production at any hour of the day or night.

As a result of these circumstances, new regulations were issued to organize women’s work in industry, especially concerning women working night shifts on land in the field at Sakair area, to protect them from the risks of travel at the time. This encouraged many girls to join the oil industry, and also, the state allocated numerous scholarships for female students to study petroleum engineering. Many of them excelled in this vital field—particularly in the Gulf region—which contributed to providing distinguished opportunities for them and for society, opportunities that had not previously existed.

After working for more than twenty years, it was time to return to the classroom and acquire new skills that were needed at the time—specifically, environmental science and sustainable development. I earned a master’s degree in this field and moved on to help the company comply with environmental



One of the field visits.

laws and regulations set by the state, including the treatment of produced water associated with oil production and ways to reuse it, such as enhance oil reservoir pressure and in agriculture. I also worked on reducing flaring of associated gas and making use of it in field power generation or reinjecting it into petroleum reservoirs to maintain their pressure and increase recovery.

Criticism of the oil industry worldwide continues, but fossil resources—oil, gas, and previously coal to an even greater extent—have contributed significantly to the development and well-being of humanity over the decades. My experience in production and environmental work, along with continuous exposure to rapid developments in both fields, has greatly helped me in my role as an environmental consultant.”

Throughout your professional career in engineering and in the oil and gas sector, could you share with our esteemed readers the most significant milestones or positions you held during this journey?

“Since the beginning of my career in the oil sector, when I joined Banoco (formerly BanooCo), the company responsible for extracting oil and gas—the country’s primary sources of revenue—I witnessed profound changes in oil industry management, extraction methods, and production techniques.

At first, the state decided to merge Banoco with Bapco (the refinery) under the unified name ‘Bapco,’ given the strong association of this name with the oil industry. At that time, I was working as a Senior Petroleum Engineer in the Petroleum Engineering Department.

As the Bahrain Field aged and maintaining its production became increasingly challenging, the government decided to privatize field operations by contracting an international company. The goal was to bring in investment and benefit from advanced production and enhanced oil recovery technologies. The responsibility for developing the field was entrusted to Occidental Petroleum Company (Oxy), with financial participation from Mubadala of the



2006 Executive Committee Meeting for Women in the Oil and Gas Sector.

UAE, under the name 'Tatweer Petroleum,' while Bapco remained responsible for exploration, refining, and marketing activities.

Occidental sought to benefit from my engineering and environmental experience, as well as my master's degree in environment, so I was appointed Senior Environmental Coordinator in the company's Health, Safety, and Environment (HSE) Department, where I was part of the founding team of this division.

In 2017, Occidental and Mubadala decided to withdraw from the Bahrain Field due to their inability to reach the targeted and profitable oil production levels, despite the significant investments made in the field and the extensive expansion of wells and production facilities. At that time, I was serving as Lead of Safety Officer for oil operations.

As part of government reforms for managing the oil and gas sector, the state established Bapco Energies in 2022, which included production and exploration activities under its asset portfolio. I was

then promoted to Lead of Environmental and Social Governance (ESG) Champion, and later to Director of the ESG Department."

In this context, it would be valuable for the readers of Al-Muhandis to learn about the most important projects you worked on during your engineering career in the oil sector.

"Some examples of the projects include:

- Numerous diverse projects and studies related to improving oil reservoir pressure, production methods, and enhanced oil recovery—such as treating produced water to reinject it into reservoirs to improve enhance reservoir pressure.
- Maintenance of oil and gas wells and stimulation of production.
- In 2006, I worked with the Society of Petroleum Engineers (SPE) and its president at the time, Ms. Eve Sprunt, to organize the first workshop dedicated to empowering women engineers working in the oil



During COP27.

industry. This coincided with the Middle East Oil & Gas Conference (MEOS), held in Bahrain every two years since the early 1980s. That workshop became a landmark event with every conference, benefiting many women engineers in the region.

- Working with the company's Land Management Department to employ GIS technologies in addressing HSE issues—making the company among the first to integrate GIS into its daily operations.
- Developing and establishing the company's ESG roadmap to implement required initiatives aimed at



One of the field visits to Aluminium Bahrain (Alba).

reducing future compliance burdens, which involve extensive decision-making.

- Collaborating with the Ministry of Municipalities and Agriculture to plant trees across the Bahrain Field and expand green areas.
- Signing an agreement with the Supreme Council for the Environment to plant mangrove trees in support of the Kingdom's plan to achieve carbon neutrality by 2060, in alignment with Bahrain's commitments under the UN Climate Change Conference (COP26).
- Developing and enhancing several HSE system applications, including the monthly contractor performance evaluation system, the contractor management application, and the environmental permits application."

How did your connection and involvement with the Bahrain Society of Engineers begin?

"Engineer Isa Janahi played an important role in introducing me to the Bahrain Society of Engineers and giving me the opportunity to join it, granting

me a lifetime membership that greatly contributed to developing my engineering personality through attending and organizing conferences, specialized training courses, workshops, and mentoring programs.

I am still an active member of the Society, with regular participation. Through it, I support young engineers in developing their skills by showcasing their projects, encouraging them in scientific research and innovation, and creating spaces for communication and engagement in engineering activities organized by the Society to exchange experience with senior engineers."

Engineer Layla Janahi is currently very present in the Society's activities. Could you share with the readers of Al-Muhandis the key events and milestones that strengthened your relationship with the Bahrain Society of Engineers?

"As a member of the Society, I have contributed to organizing many events and activities with various



One of the trips I took, New Zealand.



With representatives of the Supreme Council for the Environment during one of the inspection visits.



One of the events of Health, Safety and Environment Week.

objectives. I chaired the Environment Committee for two terms, during which we implemented many environmental initiatives, such as awareness lectures and participation in volunteer activities that had a positive impact on the environment.

I was also part of the founding team of the Women's Committee, which aims to enhance the role of Bahraini women engineers and support the initiatives of the Supreme Council for Women, helping women engineers reach higher decision-making positions.

Additionally, I have served as a judge for university engineering graduation projects for the past four years, a role I continue to perform. I was also one of the founders of the Engineering Career Day events (currently called International Exhibition of Academic Studies), which began in 2006, and I still

serve as a key member of the team. These events are held annually to promote the engineering profession by providing detailed explanations of various engineering specialties to high school students, encouraging them to pursue engineering and helping them shape their educational and career paths."

How does Engineer Layla Janahi evaluate her experience with the Bahrain Society of Engineers in organizing events and activities?

"Volunteering with the Society has been a rewarding experience, as it has greatly helped me develop logical and organizational thinking skills, as well as the ability to find solutions rather than focus on problems. It strengthened my attention to detail, team management, and coordination, and helped me develop discipline, commitment, and improved

communication skills—enhancing my effectiveness in community work. Technology has also played a major role in improving my skills.

Furthermore, my work in organizing events and occasions has allowed me to meet a wide network of engineers—men and women—and I value the friendships I have built with them.”

How does Engineer Layla Janahi view the role of the Bahrain Society of Engineers as a professional body working to advance the engineering profession in Bahrain across all disciplines?

“The Society has played a vital and essential role in developing the engineering profession in the Kingdom since its establishment in 1972. It has achieved many accomplishments that have contributed to enhancing and strengthening the competency of engineers, and it continues on this path by keeping pace with life’s changes and the evolving requirements of the engineering profession to meet the ambitions of engineers and the needs of the current job market.

Some of the Society’s notable achievements include:

- Offering annual scholarships to students wishing to study engineering in the Kingdom, supporting youth in advancing their academic level and achieving their aspirations.
- Providing advanced and accredited training programs through the Society’s Training Center, which helps develop engineers’ skills and capabilities and qualifies them to progress professionally.
- Focusing on youth by offering regular awareness lectures, training programs, and field visits.
- Establishing a dedicated Youth Committee to address the challenges young engineers face and

find solutions, helping them focus more effectively on their careers.

- Working with relevant authorities to train and employ newly graduated engineers.
- Organizing the Academic Studies Exhibition for nearly twenty years, developing it annually to keep pace with the requirements and challenges of the profession.

In addition to the above, it would be beneficial for the Society to organize more social activities that bring members together, as well as host technical seminars addressing issues of public interest such as traffic congestion and proposing future solutions. The Society has also held conferences discussing the future of industry in Bahrain and the role of renewable energy.

It is equally important to reactivate the Environment Committee and enhance its cooperation with government bodies to discuss outcomes of the annual COP climate conferences.”

With such a rich professional journey, what are the most significant professional or community honors you have received?

- “I was honored three times by the Minister of Labor on Labor Day at different intervals: in 1998 as the first female engineer to work in the Bahrain Field; in 2008 in recognition of my volunteer contributions; and finally in 2022 as one of the distinguished employees.
- In 2011, I received an award from the Society of Petroleum Engineers (SPE) in appreciation of my contributions and participation in the Society’s activities.
- In 2022, I was honored by the Leadership Excellence

for Women Awards & Symposium (LEWAS) with the ‘Woman of Achievement’ Award. LEWAS is an initiative in the energy sector aimed at empowering and recognizing women in the Middle East.

- I have also been honored at numerous conferences and forums in recognition of my contributions to organizing events or my role as a technical committee member.

However, the greatest honor I have received is the love and appreciation of people. This became especially clear to me through the tribute I recently received from the company and my colleagues upon my retirement. Their gesture truly surprised me, and I deeply felt their affection and appreciation.”

The readers of Al-Muhandis may also wish to learn about the personal side of Engineer Layla Janahi—your family life and the hobbies you enjoy.

“I am a mother of three children with whom I share a close relationship. I consider myself strict when it comes to principles that children must adhere to, but I am also democratic—I listen to their needs and opinions, and sometimes even learn from them.

My eldest son, Bader, inherited the engineering profession from me and became an engineer. Aseel works in an insurance company, and Nayef is a lawyer who recently began his career at a law firm.

After retiring, and driven by my love for sports, I joined fitness centers to make exercise a lifestyle. Traveling and exploring new destinations are also part of my retirement routine, and I have plans to visit several new places soon.

Currently, I work part-time as an environmental consultant for an American company, in addition to volunteering with private companies in organizing conferences. I am currently working with them

on organizing the first Environmental and Social Governance (ESG) Conference for 2026, along with my voluntary work with the Bahrain Society of Engineers.”

After thirty-six years in engineering and environmental work, we would like to conclude this interview with a word of advice for our young engineers.

“Through my ongoing communication with young engineers and school students during events and meetings, I believe I have contributed to empowering the new generation and guiding them toward achieving their aspirations. I have shown them that every profession—especially engineering—requires great effort and continuous learning to keep up with technological changes and modern advancements necessary to solve professional challenges.

I also advise them to commit to fieldwork at the beginning of their careers. This type of work is what truly develops an engineer’s skills, allowing them to understand problems and supervise their improvement or resolution. Fieldwork helps engineers connect directly with their responsibilities, which is essential for career advancement and gaining the necessary experience. Moreover, it strengthens communication among colleagues and reduces gaps between them, providing practical experience that better prepares them to handle future projects both scientifically and practically.

Lastly, I advise newly graduated engineers to consider working in the Gulf region rather than limiting themselves to Bahrain, due to the limited opportunities available here. Doing so will allow them to gain stronger practical experience and build connections with experts in the field, which will ultimately help them contribute to the development of the country in the future.”

Al-Munther Satellite

A Milestone in Bahrain's National Space Capabilities

Introduction:

On Saturday, the 15th of March 2025, the Kingdom of Bahrain established its maiden satellite named 'Al-Munther'-completely developed in the Kingdom of Bahrain, marking an important milestone in its journey towards building its capabilities and competencies in space.

The satellite "Al-Munther" was launched aboard a Falcon 9 rocket from the Vandenberg Space Force Base (VSFB) in the United States of America exactly at 9:39 AM local time. VSFB is an essential hub of the United States Space Force; it is situated near Lompoc, along the Central Coast of the state of California & is a prominent launching site for polar-orbiting satellites (NASA & SpaceX).

"Al-Munther" is seeking to localize satellite technology and advance Bahraini expertise in this sector. Moreover, it is the first of its kind in the region to rely on artificial intelligence solutions to analyze satellite images. This, consequently, increases the efficiency of the data it offers.

The satellite went through a number of rigorous tests in order to confirm its readiness and ability to survive the tough environment of space. These tests had been carried out at satellite testing facilities both regionally and globally.

The successful launch of the "Al-Munther" satellite marks the formal declaration of the Kingdom of Bahrain's presence in the space sector, because there will now be an integrated environment of knowledge and space infrastructure that will support Bahrain in this area. The Bahrain Space Agency has ambitions that begin with this achievement and are currently conducting studies for further satellites that will satisfy the requirements of the Kingdom and support the expansion of space infrastructure within Bahrain.

This is the start of a new era for the Kingdom of Bahrain, and it shows that the Kingdom does have the ability and potential to move forward with space, as it is capable of participating and completing a space project with the necessary technologies that will determine a bright and promising future. Most importantly, the project shows that the Kingdom is putting effort and focus on developing its youth, who will be the ones shaping a promising and brighter future.

After the success experienced with the launch of the satellite called "Al-Munther", the team of engineers who designed and managed the satellite took pride in this national success and emphasized the huge efforts made to achieve it despite the challenges they had experienced throughout the process.

The statements of engineers, who took part in this historical endeavor, are quoted below.



Follow-up on the launch of the "Al-Munther" satellite

Eng. Aisha AlHaram – Project Manager:

"Al-Munther represents the future of Bahraini space capabilities. Every phase—from design to deployment—was handled by national talent, proving our engineers' readiness to lead high-stakes space missions."

Eng. Yaqoob AlQassab – Systems Engineering Lead:

"Achieving seamless integration of complex subsystems was critical. We met the challenge head-on, resulting in a high-reliability satellite tailored for real mission demands."

Eng. Amna AlBalooshi – Risk & Quality Manager:

"Our proactive risk management framework enabled us to navigate technical uncertainties and ensure operational readiness for space deployment."

Eng. Ali Al Mahmood – Cybersecurity Systems Engineer:

"Space-grade encryption and authentication algorithms were embedded into Al-Munther to secure national assets against unauthorized access."

Eng. Reem Sinan – Communications Lead:

"We developed Bahrain's first satellite control system, enabling autonomous operation and future scalability for multi-mission architectures."

Eng. Ali AlQur'aan – Power Systems Lead:

"The mission built upon lessons from our prior satellite, 'Light-1,' transitioning us to full satellite system design and integration independence."

Eng. Ahmed Boushleibi – Mission Planning Analyst:

"Orbital optimization and pass analysis were key to maximizing ground contact and data yield, ensuring mission efficiency."

Eng. Ashraf Khater – Mechanical Lead:

"Our structural design met stringent constraints of mass, thermal stability, and vibration endurance—critical for survivability in launch and orbit."

Eng. Muneera Al-Malki – EO Payload Developer:

"Our camera system delivers high-quality data tailored to national needs and optimized via onboard image processing before downlink."

Eng. Yousef Al-Qattan – Integration & Testing Lead:

"We validated every subsystem through real-world environmental simulations to guarantee mission resilience."

Eng. Marwan AlMeer – Frequency Registration & Ground Segment:

"By establishing Bahrain's first satellite ground station and securing international frequency registrations, we've built the infrastructure for long-term space operations."

Statement by Dr. Mohamed Ibrahim Al-Aseeri, CEO

"This mission embodies Bahrain's strategic vision under the leadership of His Majesty King Hamad bin Isa Al Khalifa. The relentless pursuit of innovation and self-reliance in space technology is now a reality, and we are proud to lead this journey into the future of Bahraini space exploration."

Bahraini Hands Launch "Al-Munther" Satellite to Enhance National Space Capabilities

In an unprecedented national achievement, the Kingdom of Bahrain announced today the successful launch of its first domestically developed satellite, "Al-Munther." The satellite was fully designed and developed by Bahraini engineers at the Bahrain Space Agency, marking a milestone in the nation's efforts to localize space technology and strengthen its technical



capabilities in this strategic domain. This launch paves the way for increased self-reliance in the development of future space initiatives.

"Al-Munther" represents a practical embodiment of Bahrain's vision to achieve autonomy in space technology and to foster the development of national capabilities that contribute to sustainable development. Since the project's inception, the Bahrain Space Agency has focused on building local expertise by managing the satellite's design, development, and operations entirely within the Kingdom, while also leveraging regional and international collaborations to ensure adherence to the highest standards in space engineering.

A National Vision for Building Advanced Space Capabilities

The "Al-Munther" project constitutes a significant step toward the localization of space technologies in Bahrain. It enabled a team of young Bahraini engineers to gain hands-on experience in the development of advanced space systems—from

mission concept formulation and engineering requirements definition to system design, software development, and the execution of environmental and operational testing. The project also facilitated technology transfer and laid the groundwork for future space missions led by Bahraini engineers.

A New Milestone in Bahrain's Journey Toward Space Leadership

"Al-Munther" was launched into its designated orbit aboard a SpaceX Falcon 9 rocket, as part of the Transporter-13 mission. The launch took place at 9:43 a.m. Bahrain time on March 15, 2025, from Vandenberg Space Force Base in California, USA. The satellite successfully separated from the launch vehicle and entered a sun-synchronous orbit at an altitude of 550 kilometers above sea level. It will now undergo a series of in-orbit tests to validate its readiness for full operational deployment.

"Al-Munther": A Technological Platform Showcasing Bahrain's Progress in the Space Sector

Following the successful deployment of "Al-Munther," the Bahrain Space Agency is preparing to commence the satellite's initial operational phase. During this stage, Bahraini engineers will conduct in-orbit testing of the satellite's subsystems before activating its advanced technical payloads. This step reinforces Bahrain's growing position in the development and application of nanosatellite technologies across various space-related domains.

Advanced Technical Design for Multifunctional Space Missions

"Al-Munther" is a nanosatellite weighing approximately 3.2 kilograms, operating in a sun-synchronous orbit at an altitude of 550 kilometers above sea level. Engineered to perform a range of integrated missions, the satellite has

been developed with advanced data processing and analysis capabilities, enabling it to operate effectively in the harsh environment of space.

The Four Payloads of the Al-Munther Satellite

The Al-Munther satellite carries four primary technical payloads, each aligned with Bahrain's strategic vision to enhance its presence in the space sector:

1. Remote Sensing Payload – Medium-Resolution Space Camera

Al-Munther is equipped with a medium-resolution spaceborne camera (20 meters per pixel) designed to capture imagery of the Kingdom of Bahrain and its territorial waters. This camera supports a range of governmental and scientific applications, including environmental monitoring, agricultural assessment, urban development tracking, and coastal surveillance.

Advanced artificial intelligence algorithms, developed by engineers at the Bahrain Space Agency, will be applied to the captured imagery to enhance resolution and efficiently analyze data before transmission to the ground station.

2. Artificial Intelligence Payload – Onboard Image Processing and Analysis

One of Al-Munther's most distinctive features is its onboard capability to process and analyze satellite imagery using artificial intelligence—a first of its kind among nanosatellites in the region. This payload represents a key technological innovation, with a custom-developed AI software that autonomously analyzes captured images before transmission.

The AI system classifies images based on quality and scientific relevance. Low-quality or unusable images (e.g., cloud-covered, blurred, or dark scenes) are compressed and archived onboard,

reducing the volume of data transmitted to Earth. This improves communication efficiency between the satellite and the ground station, and optimizes onboard power consumption.

This approach marks a paradigm shift in nanosatellite data handling, enabling preliminary in-orbit data analysis and thus conserving ground-based resources and operational time.

Cybersecurity Payload – Protecting Satellite Data

Amid the growing cyber threats targeting space assets, Al-Munther has been equipped with a dedicated space cybersecurity payload. This fully Bahraini-developed technology is designed to safeguard satellite data using advanced encryption techniques, ensuring the integrity and confidentiality of the information by preventing unauthorized access or tampering.

The system also incorporates identity verification algorithms to ensure that only authorized operators can execute commands or access satellite systems. This payload significantly enhances Bahrain's digital sovereignty in space security and strengthens the protection of its space-based assets.

Radio Broadcasting Payload – Promoting National Identity in Space

One of the unique features of Al-Munther is its radio broadcasting payload, specifically designed for amateur radio enthusiasts worldwide. The satellite transmits the Bahraini national anthem over dedicated amateur radio frequencies, allowing reception around the globe using basic radio equipment.

In addition, it broadcasts a recorded message from His Majesty the King, transmitted as digital signals that can be decoded and read by amateur radio operators and satellite receiving stations.

This initiative aims to promote Bahrain's achievements in space and elevate its international presence in the field, while also offering a symbolic and interactive connection between space technology and global communities.

Pre-Launch Testing and Preparations

Al-Munther underwent a comprehensive series of rigorous tests to ensure its resilience in the harsh space environment and operational reliability post-launch.

The payload readiness tests were conducted at the National Space Science and Technology Center in the United Arab Emirates, focusing on verifying the performance of the onboard space camera under simulated space conditions.

Environmental testing was performed at the Egyptian Space Agency laboratories, including thermal vacuum tests and vibration tests to simulate the stresses experienced during launch and orbital operations.

Final integration and readiness tests were completed in the Kingdom of the Netherlands in collaboration with ISISPACE, where full satellite integration and space-readiness validation were performed.

These extensive test campaigns were critical to ensuring the satellite's functionality and significantly increased the probability of mission success.

Team Reflections

Following the historic success of Al-Munther's launch, members of the engineering team responsible for its design, development, and operation expressed immense pride in this national achievement. They emphasized the substantial effort and perseverance that went into



overcoming the numerous challenges throughout the project lifecycle.

Below are the full statements from the engineers who contributed to this pioneering mission.

Engineer Aisha Al-Haram – Project Manager of Al-Munther Satellite

"First and foremost, I extend my heartfelt thanks and appreciation to everyone who contributed to the successful launch of the Al-Munther satellite. This proud national achievement reflects the capabilities and competence of Bahraini youth in the space sector. I would especially like to thank all members of the Bahrain Space Agency, led by H.E. Dr. Mohamed Ibrahim Al-Aseeri, CEO of the National Space Science Agency, for their unwavering support and deep trust in national talent, which formed the cornerstone of turning

this dream into reality.

The project was a significant challenge, but it carried within it immense opportunities for developing and refining the skills of Bahraini engineers in the design and development of advanced space systems. From the outset, we had a clear goal—to build a Bahraini satellite incorporating innovative technologies that demonstrate the capabilities of our engineers and their ability to manage advanced space projects.

The project passed through several phases—from planning and design to testing and integration—each presenting new challenges that demanded creative thinking and innovative solutions. The team rose to the occasion, working tirelessly to meet our objectives within the planned timeline.

Without a doubt, the launch of Al-Munther marks

Bahrain's official entry into the space era with confidence and ambition. It represents a turning point in the localization of space technologies in the Kingdom.

Today, with the satellite successfully in orbit, we are filled with immense pride, but we also recognize that this is just the beginning of a journey full of achievements. It is the foundation on which we will build future projects in this vital field. What we accomplished today is the result of collective effort and a shared vision."

Engineer Yaqoub Al-Qassab – Systems Engineering Lead, Al-Munther Satellite

"Designing the space systems for the Al-Munther satellite was a deeply challenging experience that required us to achieve precise integration across all subsystems to ensure the satellite's orbital stability and the effective execution of its assigned tasks.

We had to design and implement fully integrated systems—including power, control, communications, and sensing—while ensuring all components operated in harmony without any faults that could compromise mission performance.

The satellite was developed according to the latest technical standards and includes a comprehensive set of subsystems: the power system, composed of batteries and solar panels to provide necessary energy for operations; and the mechanical system, which includes the satellite structure, designed to withstand the harsh conditions of space.

We were also committed to adhering to all international protocols and guidelines concerning space debris mitigation and the sustainability of space activities.

Seeing Al-Munther launch into space was a moment of immense pride for all of us—but it was also the beginning of a new responsibility. The work

doesn't end with launch; it continues through the operations phase to ensure the satellite performs effectively and meets its scientific and technical objectives.

We are proud of how far we've come and look forward to the successful completion of the mission and the realization of the strategic goals of this ambitious national project."

Engineer Amina Al-Balooshi – Risk and Quality Management Lead, Al-Munther Satellite

"Risk management in space missions is a fundamental component in ensuring the success of any satellite project. Satellites are exposed to a range of technical and environmental challenges from the design phase, through launch, and during orbital operations. For Al-Munther, our mission was to identify all potential risks, develop mitigation plans, and reduce their impact to maximize the probability of mission success.

From the earliest stages of the project, we implemented a comprehensive risk assessment framework. We identified various scenarios that could affect the satellite's performance—whether during manufacturing, launch, or in-orbit operations. This included analysis of intense vibrations during launch, thermal fluctuations the satellite would experience while orbiting Earth, and potential communication disruptions due to radiation interference or orbital dynamics.

One of the major challenges we faced was ensuring that all mechanical, electrical, and electronic systems met the satellite's operational requirements. This demanded a high level of precision in design and constant coordination among all engineering teams. We also had to verify that all tests conducted on the satellite accurately simulated the actual conditions it would face in orbit, to guarantee operational stability in space.

Through the implementation of a rigorous risk management strategy, we ensured that Al-Munther was fully prepared to operate in the harsh environment of space, thereby increasing the mission's chances of success. Watching the satellite reach its orbit safely is a testament to the dedication and effort of the entire team at every stage of the project, and I am proud to have been part of this national achievement."

Engineer Ali Al-Mahmood – Software Development Lead, Al-Munther Satellite

"In today's digital era, ensuring the highest levels of cybersecurity for all technological systems is essential, especially in response to increasingly sophisticated cyberattacks that threaten both terrestrial and space-based assets. These threats extend beyond ground systems to include space infrastructure like satellites, where cyberattacks represent one of the primary risks to mission integrity and operational success.

To address this, advanced onboard cybersecurity systems were developed for Al-Munther. These systems employ authentication and encryption technologies to secure the satellite's payload data. Authentication ensures that only authorized personnel or systems can execute operations on the satellite, reducing the risk of unauthorized access or control. Meanwhile, encryption prevents data breaches and protects sensitive information from cyberattacks or espionage attempts.

One of the key challenges we faced during development was balancing the need for robust security with the technical limitations imposed by the space environment—such as the satellite's limited computational capacity and restricted data bandwidth. We developed specialized algorithms capable of efficiently encrypting data without compromising overall satellite performance.

Now that Al-Munther has successfully reached orbit, we take pride in having contributed to the

protection of Bahrain's space data. Our work enhances the Kingdom's ability to conduct secure and autonomous space operations, paving the way for a more prominent and independent role in the global space sector."

Engineer Reem Sinan – Communications Systems Lead

"One of the most significant achievements we accomplished was the development of a Bahraini-made operating system for managing the satellite and its onboard payloads. This contributes to the localization of advanced space technologies and enhances Bahrain's autonomy in operating its satellites. The system enables the satellite to perform its designated tasks—such as data collection, processing, and transmission to Earth—while ensuring that it fulfills its mission objectives efficiently and effectively, including the management of all onboard payloads.

Moreover, the ground station established to support Al-Munther's operations will enable us to manage the satellite with high efficiency, support future space missions, and potentially receive data from other free satellites operating on similar frequencies. The success of the satellite's initial contact with the ground station after launch will be a pivotal moment. It will confirm that all communication systems are functioning as planned and allow us to begin scientific operations in a gradual and steady manner."

Engineer Ali Al-Qur'an – Power Systems Lead

"The launch of this project came directly after the completion of the Light-1 satellite mission, reflecting the Agency's commitment to continuously advancing the knowledge and skills of its personnel. The Al-Munther project represents a significant step forward in building national capabilities and keeping pace with the latest technologies in the space sector.

During Light-1, the team focused on designing and implementing a scientific payload for studying gamma rays in the upper atmosphere, which provided us with deep insights into systems integration and launch-to-orbit operations. With Al-Munther, the team advanced further, taking on new challenges such as the complete integration of the payload inside the satellite, managing data using advanced AI-driven processing systems, and applying encryption and cybersecurity algorithms to protect space data.

The Al-Munther project is more complex than Light-1, requiring the development of integrated electronic systems within a compact satellite environment. This pushed us to acquire new expertise in space-grade printed circuit board (PCB) design and in analyzing thermal and mechanical performance to ensure reliable operation in orbit.

The project also enhanced our integration and functional testing capabilities. We implemented strict verification procedures to ensure all launch and operational requirements were met. The transition from Light-1 to Al-Munther was not just a move to a new project—it was a qualitative leap toward greater independence in designing and developing space systems. It paves the way for more complex and larger missions in the future and supports Bahrain's vision for a knowledge-based economy driven by innovation and advanced technologies."

Engineer Ahmed Boushleibi – Mission Planning and Orbital Performance Analyst

"My role in this project centered on orbit analysis and planning the operations of the Al-Munther satellite, a critical aspect that directly impacts mission success. We had to study numerous factors, such as satellite pass times over the ground station, coverage durations, and revisit intervals, to ensure we could maximize the utility of the collected data.

We worked on determining the most suitable orbit that would allow the satellite to perform its tasks efficiently, taking into account how orbital dynamics affect energy consumption, data transfer rates, and mission lifespan. After the launch, and once all components are confirmed operational, we will continue to monitor the satellite's trajectory and adjust operational strategies based on incoming data.

The main challenge was ensuring the satellite would maintain sufficient communication windows with the ground station to send commands and receive data effectively. Now that Al-Munther has reached orbit, a new phase begins—focused on system operation and performance monitoring. I am proud to have contributed to this national achievement and eagerly look forward to participating in the next national space project, where I will apply all my knowledge and skills to help Bahrain continue its leadership in the space sector."

Engineer Ashraf Khater – Mechanical Systems Lead for Al-Munther

"The mechanical system of the satellite is one of the most critical components ensuring the success of the mission. It is responsible for protecting internal components from the harsh conditions the satellite experiences, both during launch and in space. We had to ensure that the satellite's structure could withstand the extreme space environment while also adhering to space sustainability standards, which help reduce space debris and optimize resource efficiency.

During the design phase, the biggest challenge was achieving an ideal balance between weight, rigidity, and volume—ensuring the satellite could house all scientific payloads and electronic systems without compromising performance in orbit. To this end, we conducted a series of mechanical analyses and precise simulations using advanced and complex software, ensuring all components were correctly

positioned and capable of operating under space conditions.

Seeing Al-Munther successfully reach its designated orbit means that all the effort invested in designing its structure was well-placed. Today, I am proud to be part of the engineering team that worked with dedication, passion, and sincerity in service of Bahrain to realize the dream of space leadership."

Engineer Muneera Al-Maliki – Space Camera Payload Developer

"Developing the satellite's space camera payload required a high level of precision in design, assembly, and calibration to ensure it could capture clear, high-quality images in the harsh environment of space. We had to consider all factors that could affect the camera's performance, from launch-induced vibrations to exposure to cosmic radiation and rapid temperature fluctuations in orbit.

One key feature we worked on was onboard image processing, which allows for enhancing image resolution and analyzing data before transmission to Earth. This capability maximizes the utility of the collected data while minimizing the need to transmit large volumes of unnecessary data, thus conserving the satellite's energy.

Seeing the camera we developed operating successfully in space will be a remarkable moment for all of us. It will stand as a testament to our efforts and our commitment to achieving the highest standards in space imaging technology."

Engineer Yousef Al-Qattan – Integration and Testing Lead

"Conducting the final tests for the Al-Munther satellite was one of the most sensitive and crucial phases of the project. The satellite underwent an intensive series of environmental and mechanical tests to ensure it was fully prepared for operation in orbit. These tests included measurements related to vibration and mechanical shock resistance, simulating the harsh conditions the

satellite would face during launch.

We also tested the satellite's resistance to thermal vacuum conditions, where it is exposed to extreme temperatures—ranging from intense solar heat to deep cold—in the absence of an atmosphere. Our primary goal in these tests was to ensure the satellite's stability in space and prevent any malfunctions that could impact its performance after deployment.

The satellite's success in passing all these tests reflects the precision in design and the careful planning the team adhered to throughout all stages of development."

Engineer Marwan Al-Mir, Frequency Registration Officer and Member of the Ground Station Team

"One of the key roles I worked on was organizing and registering the satellite's frequencies to ensure its ability to communicate without interference from other satellites. This process requires coordination with relevant authorities locally and internationally. I was also part of the team that worked on establishing the first fully integrated Bahraini ground station for communication with satellites, which will mark a significant shift in Bahrain's ability to autonomously operate and manage its space missions. This station is not only for 'Al-Munthir,' but it will also serve future projects and open the door for more international cooperation in conducting space missions from Bahrain. Achieving such an accomplishment means that the Kingdom of Bahrain now has a space infrastructure capable of supporting more projects in the future, enhancing the Kingdom's position in the space sector."

Dr. Mohammed Ibrahim Al-Asiri, CEO of the Agency and Project Supervisor

"This project is a step in the agency's journey to realize the vision of His Majesty King Hamad

bin Isa Al Khalifa, the King of Bahrain, may God protect him, to position the Kingdom of Bahrain as a pioneering leader in the space sector, and to implement the directives of His Royal Highness Prince Salman bin Hamad Al Khalifa, Crown Prince, Deputy Supreme Commander of the Armed Forces, and Prime Minister. This project has been continuously followed up and supervised by His Highness Sheikh Nasser bin Hamad Al Khalifa, National Security Advisor, Commander of the Royal Guard, and Secretary-General of the Supreme Defense Council, throughout its implementation stages. The project began as an idea that was embraced and supported by His Highness, who was keen on overseeing its various stages and ensuring all challenges were overcome and the necessary support was provided to the agency to complete all requirements within the available time frame to finalize the project. We extend our heartfelt thanks and appreciation to His Highness for his support to the agency.

As confirmed by the statements of the engineering team members of the 'Al-Munthir' satellite, the efforts exerted and the challenges overcome to make this ambitious national project a success were immense, starting from planning and design to testing, operation, and ensuring the conversion of data into added value that meets national needs. Collective work and dedication to research and development played a pivotal role in the success of this project and in achieving this proud national accomplishment, which highlights the Kingdom of Bahrain as a leading country in the space sector and advanced technologies."

Launch Information

The "Al-Munthir" satellite was launched using a Falcon 9 rocket, developed by SpaceX. The Falcon 9 rocket is one of the most famous space rockets in terms of the number of successful launches,

thanks to its reusable design, which reduces the cost of reaching space.

Technical Details about the Falcon 9 Rocket

1. Type: Two-stage rocket, partially reusable.
2. Length: 70 meters.
3. Diameter: 3.7 meters.
4. Maximum payload to Low Earth Orbit (LEO): 22,800 kg.
5. Maximum payload to Geostationary Transfer Orbit (GTO): 8,300 kg.
6. Fuel: RP-1 kerosene and Liquid Oxygen (LOX).

Launch Phases

1. First Stage: Lift-off and Return to Earth
 - o Upon lift-off, the Falcon 9 rocket uses 9 powerful engines that propel it with immense force to overcome gravity and leave the Earth's surface.
 - o These engines can be compared to aircraft engines during takeoff, as they provide the necessary energy to ascend into the air.
 - o Once the rocket reaches a certain altitude, this phase ends, and it separates from the rest of the rocket components and begins its journey back to Earth.
 - o Unlike most rockets that crash after use, Falcon 9 is capable of landing vertically on a dedicated platform, allowing it to be reused for future missions, much like an aircraft that can land and take off again.

2. Second Stage: Delivering the Payload to Orbit
 - o After the first stage separates, the second stage begins its operation using a single engine designed specifically for use in the vacuum of space (where there is no air to support combustion as on Earth).
 - o This phase can be compared to high-altitude flight after takeoff, where the direction is adjusted to reach the final destination.

- o This stage is responsible for delivering the satellite or payload to the required altitude.
- o The engine can be reignited to adjust the payload's position in the correct orbit, similar to how a pilot adjusts the aircraft's course before reaching its destination.

3. Third Stage: Separation and Payload Deployment

- o After reaching the designated orbit, the protective fairing that was shielding the payload during the flight is opened.
- o The "Al-Munthir" satellite is then deployed into space to begin its journey in the specified orbit.

Post-launch Operational Phase

With the successful arrival of the satellite in its orbit, a new phase begins, which involves testing the systems and ensuring their readiness to begin operational activities. These tests are expected to continue for several weeks before the satellite's actual scientific operations commence, including capturing images and activating space payloads. The first data and images captured will be received and analyzed by the engineering team at the ground station in Bahrain. The team will closely monitor the satellite's performance to ensure the maximum benefit from this mission, which is Bahrain's first of its kind.

Local Collaboration and National Support for the "Al-Munthir" Project

The "Al-Munthir" project received support from various national institutions, with the Bahrain Defense Force playing a pivotal role in providing the necessary infrastructure for the ground station, enabling technical teams to establish an integrated operational environment to monitor the satellite after launch. Additionally, the Ministry of Interior, the Ministry of Foreign Affairs, the Ministry of Finance and National Economy,

the Ministry of Information, and the National Communications Center were part of the support system for the project, facilitating logistical and media operations to ensure the success of the space mission. The Ministry of Transportation and Communications and the Telecommunications Regulatory Authority also helped with frequency registration to ensure the satellite "Al-Munthir" operated within international standards for space communications. Moreover, Bahrain Polytechnic contributed by providing its laboratories for conducting some of the electronics-related experiments. Local collaboration was not limited to government institutions; some Bahraini startups played a key role in designing certain satellite components, with some parts being developed to meet the strict space requirements, reflecting the private sector's ability to contribute to the development of advanced technologies that meet the needs of future space projects.

Towards Further Space Innovation

In this way, "Al-Munthir" represents Bahrain's official entry into the world of space, through the establishment of an integrated system of technical knowledge, engineering skills, and space infrastructure that will support future efforts in this field. The Bahrain Space Agency aims to build on this success by studying the development of new satellites that meet the Kingdom's needs and contribute to expanding the national space infrastructure. This project marks the beginning of a new era for the Kingdom of Bahrain in space, where the Kingdom has proven its ability to enter this field strongly by executing a space project, developing technologies, and acquiring skills that will pave the way for a brighter future in the space sector. Most importantly, it represents a step forward in investing in its young national workforce, who will lead the way towards further progress and leadership in this sector."



During a visit to the Agency's headquarters in the New Administrative Capital

Exploring avenues of cooperation between the Bahrain Society of Engineers and the Egyptian Space Agency

A delegation from the Bahrain Society of Engineers (BSE) conducted a scientific and professional visit to the Egyptian Space Agency in the New Administrative Capital of the Arab Republic of Egypt on Sunday, November 23rd, 2025.

At the beginning of the meeting, Engineer Dr. Majed Ismail, the Chief Executive Officer (CEO) of the Egyptian Space Agency, welcomed the delegation of the Bahrain Society of Engineers to the Agency, expressing the Agency's aspiration to build bridges of cooperation with the Bahrain

Society of Engineers in organizing joint events in this regard. He praised the ongoing collaboration and coordination with the Bahrain Space Agency (BSA) to advance bilateral joint efforts as a nucleus for Arab cooperation in research and professional aspects of space sciences. The CEO of the Egyptian Space Agency also commended the role of the Bahrain Society of Engineers and the activities it undertakes to support the engineering sector, including the space sector.

From her side, Dr. Raida Al Alawi, President of the Bahrain Society of Engineers, expressed her



Exchange of commemorative gifts between Dr. Raeda Al-Alawi, President of the Bahrain Society of Engineers, and Dr. Majid Ismail, CEO of the Egyptian Space Agency

gratitude for the Agency's hosting of this visit and for providing the members of the Bahrain Society of Engineers with the opportunity to closely learn about the Egyptian Space Agency, its role, and its research, scientific, and training programs in the field of space. She indicated that the choice to visit the Egyptian Space Agency was due to its pioneering capabilities in space technologies and their development, as well as its prominent role in scientific research and specialized qualification in this field.

During the meeting, an introductory presentation was delivered about the Society, its objectives, its role in developing and advancing the engineering sector and the profession, and its role in organizing conferences and events that have become among the Society's achievements - currently reflected in

its presidency of the Communications, Information, and Space Committee. The presentation also highlighted the role of the Society's Training Center and its implementation of professional training programs for engineers in both the public and private sectors.

Dr. Raeda Al Alawi also reviewed the professional partnerships and memoranda of understanding that the Society has established with numerous official and professional entities, both locally and internationally, and their prominent role in advancing the Society's work and activities by fostering opportunities for collaboration between both sides.



This Visit... A Confirmation of the Success of Bahraini-Egyptian Cooperation in the Field of Space

Among the objectives of the Bahrain Society of Engineers' visit to the Egyptian Space Agency was to support and enhance cooperation between the Society and both the Egyptian Space Agency and the Bahrain National Space Science Agency. This is especially significant given that the existing cooperation between the two agencies has led to several successes in the field of space exploration. Notably, the most prominent achievement was announced by the Bahrain National Space Science Agency regarding a historic Arab accomplishment, the first of its kind in lunar exploration. This was achieved through the victory of the joint Bahraini-Egyptian project in the global competition organized by the China National Space Administration. This global competition aimed to launch the winning payloads for free aboard the Chinese lunar exploration mission, Chang'e-7, scheduled for launch in 2026. The mission will explore various elements and compositions of the soil at the Moon's south pole, including the detection of water ice.

The winning project involved the design, construction, and testing of a multispectral camera for studying lunar surface materials. It was entirely executed by engineers from both agencies, representing a turning point in Arab contributions to global space projects and highlighting the distinction of national and Arab competencies capable of competing in the field of lunar exploration - a domain still limited to a small number of countries worldwide.

Therefore, the Bahrain Society of Engineers looks forward to enhancing and supporting cooperation between the Kingdom of Bahrain and the Arab Republic of Egypt in the field of space. It aims to leverage the Memorandum of Understanding signed between the two sides in 2022, as well as the Society's existing MoU with the Bahrain National Space Science Agency, and aspires to sign a similar MoU with the Egyptian Space Agency. This stems from the paramount importance of joint work in scientific and technical sectors to strengthen the standing of the two brotherly countries in the international scientific community for space sciences.



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and the Minister of State for Housing Affairs

H.E. Eng. Abdul Latif Hamed Al-Meshari

Gulf Engineering Forum 27



Conference
Investment and sustainability
challenges of smart infrastructure projects

Kuwait Society of Engineers
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Participants: Members of the Gulf
Engineering Union



The Sixth Bahrain Society of Engineers Award: Winning Projects

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

Innovation and Learning Centre for STEM (Science, Technology, Engineering, and Maths) Students

Place: 2nd

Student: Seraj Mohsen Husain

Supervisor: Dr. Mona Al Dossary - University of Bahrain

This project proposes a centre for innovation and learning serving as a "testbed" and incubator for innovative methods and technologies to promote improved educational policies and procedures in STEM subjects (Science, Technology, Engineering, and Maths).

This educational centre functions as a hub that fosters the talented students and provide a transformative space of creativity, exploration, and discovery for STEM-majors public university students and few selected students in Secondary public schools, which open the opportunities for them to engage with professionals in these fields. Upon which, they will exchange ideas,

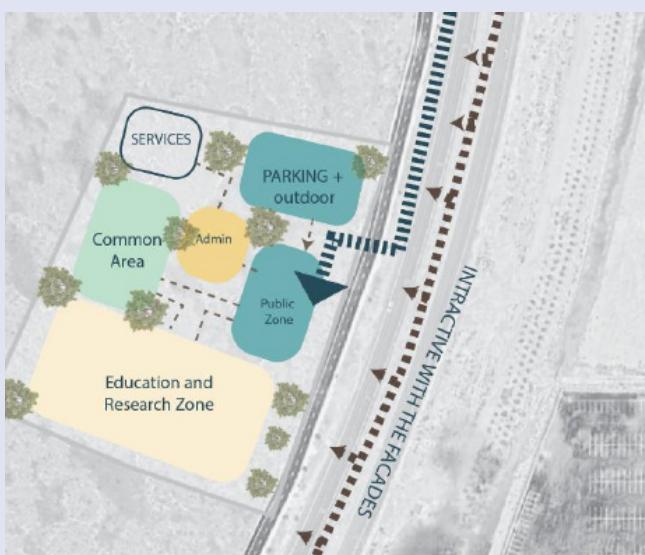


develop and explore new educational trends beyond university settings, and elevate the national dialogue on STEM education and skills.

The purpose of the innovation and learning centre is to be a learning tool and to offer cutting-edge technologies and highly equipped facilities that support the students to learn, practice, experiment, and shape their skills and knowledge through comprehensive services. It offers specialized amenities (laboratories and workshops), resources, mentorship, educational programs, and interactive experiences that enable the users to realize their full potential and work on their skills. An innovation centre is intended to conduct brainstorming sessions, design sprints, or innovation workshops. It is a place where people may congregate and apply design thinking for innovation directly. It would also function as a designated area where organizations of all kinds may promote creativity and development, that would help the students in developing their talents and open the

door for investment opportunities for selected projects developed in the centre. Additionally, external events would be hosted in the centre, helping to merge the public audience in certain times with the main users and engage them with the centre.

There are several passive design solutions and sustainable energy resources that could be integrated into the designing of the innovation and learning centre that could enhance the efficiency and the operation of the project. Passive designs consider the local climate of the site to make the most of it to avoid the building gaining heat and to improve air quality, which could be done through the orientation of the building, the positioning of the masses, and the location of fenestrations and shading devices. On the other hand, there are natural resources that are utilised as the sun, wind, and earth heat, to generate energy that supports the centre and reduce the electricity cost. As laboratories are special spaces, they have additional equipment to improve the usage of the space.



Zoning of the main components on the site



Functional zoning around the site. Source: google earth



2

Chemical Engineering

Advanced Control Strategies for Optimizing Blood Glucose Management

Place: 1st

Students: Ali Yunes Alhaddar

Jasim Mohamed Alasfoor

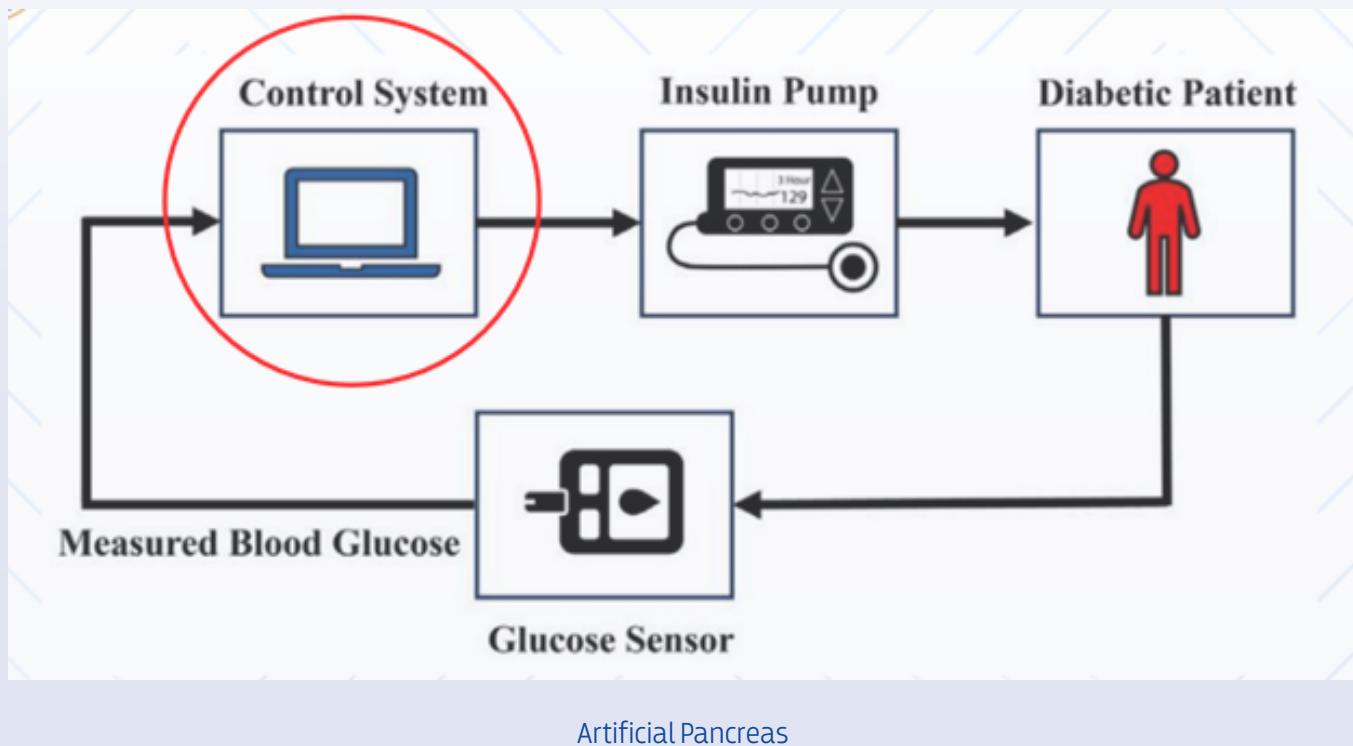
Sayed Hadi Jaafar

Supervisor: Dr. Mohamed Abdelrahim - University of Bahrain

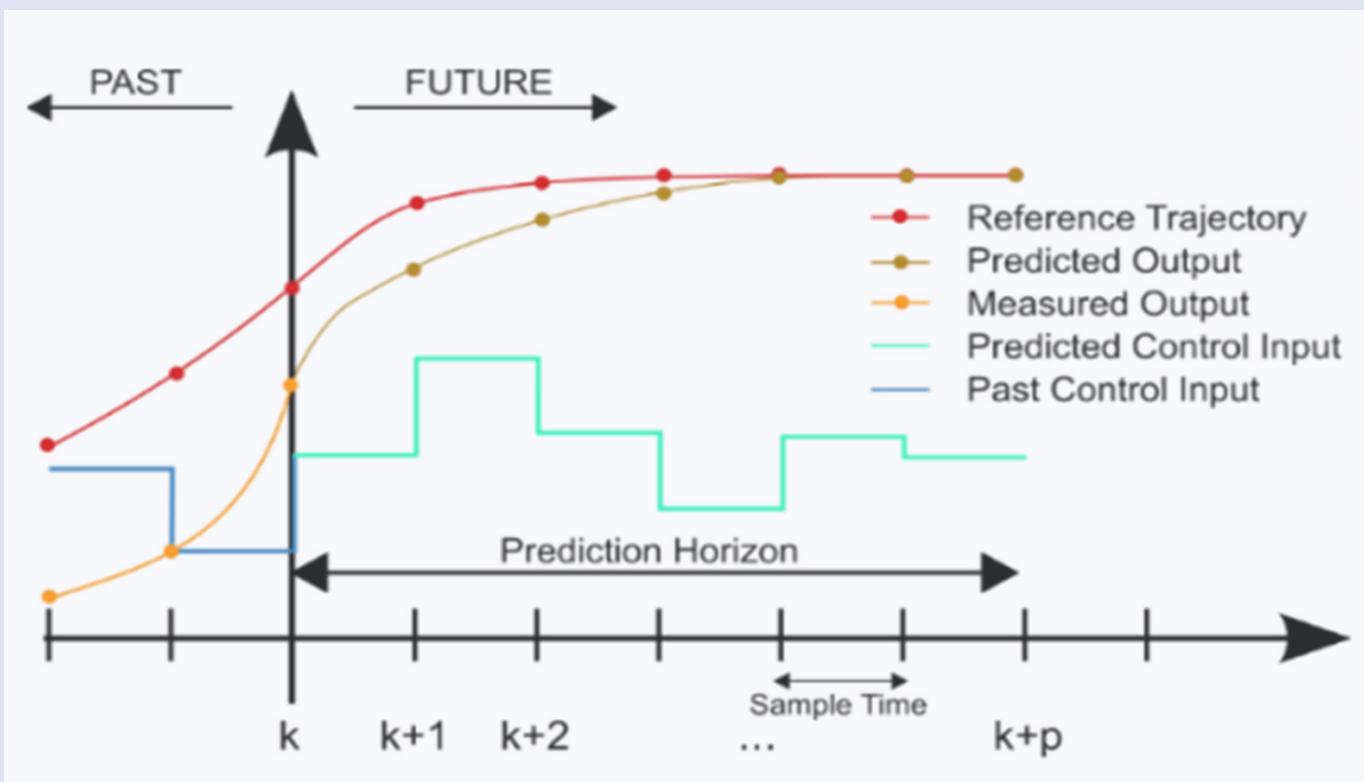
Co-supervisor: Dr. Ghassan Murad

The modeling and control design of an advanced Artificial Pancreas of Type-1 diabetic patients is one of the very challenging and complex tasks in both clinical and control fields. The Hovorka glucose–insulin model, developed at the University of Cambridge's Metabolic Technology Research group, was implemented and validated in MATLAB/SIMULINK. Five controllers; Proportional–Integral–Derivative (PID), Fuzzy Logic Control (FLC), linear Model Predictive Control (MPC), Gain-Scheduled MPC (GSMPC), and Nonlinear MPC (NMPC) were designed to regulate blood-glucose levels. Each controller was evaluated under two setpoint-regulation scenarios (hypoglycemia and hyperglycemia) and six meal-disturbance scenarios featuring both carbohydrate-estimation errors and delayed meal announcements, testing for robustness and safety. Performance was quantified using nine metrics: Time in Range (TIR), Time Below

Range (TBR), Time in Tight Range (TITR), Time Above Range (TAR), their area under curve counterparts, and Glycemic Variability (GV). Across all tests, MPC-based controllers outperformed PID and FLC. Among all implemented control strategies, the GSMPC excelled at the clinical primary objective which is minimizing TBR to 0% and maximizing TIR up to 100% even under 50 % meal size estimation errors. Nevertheless, the linear MPC achieved the best tight range control, and lowest TAR together with the NMPC. Although NMPC effectively captured nonlinear dynamics, due its high computational demands, lighter tuning was applied. This caused it to rank just behind MPC and GSMPC in overall performance. These results demonstrate that model-based predictive strategies offer the optimal balance of safety, efficacy, and robust performance for next-generation Artificial Pancreas systems.



Artificial Pancreas



Constrained Model Predictive Control Unit



3

Architecture

Design of Post Tensioned Flat Slab Reinforced Concrete Rotating Building

Place: 1st

Students:

Aaya Ali Ebrahim

Shahd Habeel Alkhayyat

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Supervisor: Dr. Muhammad Ajmal - University of Bahrain

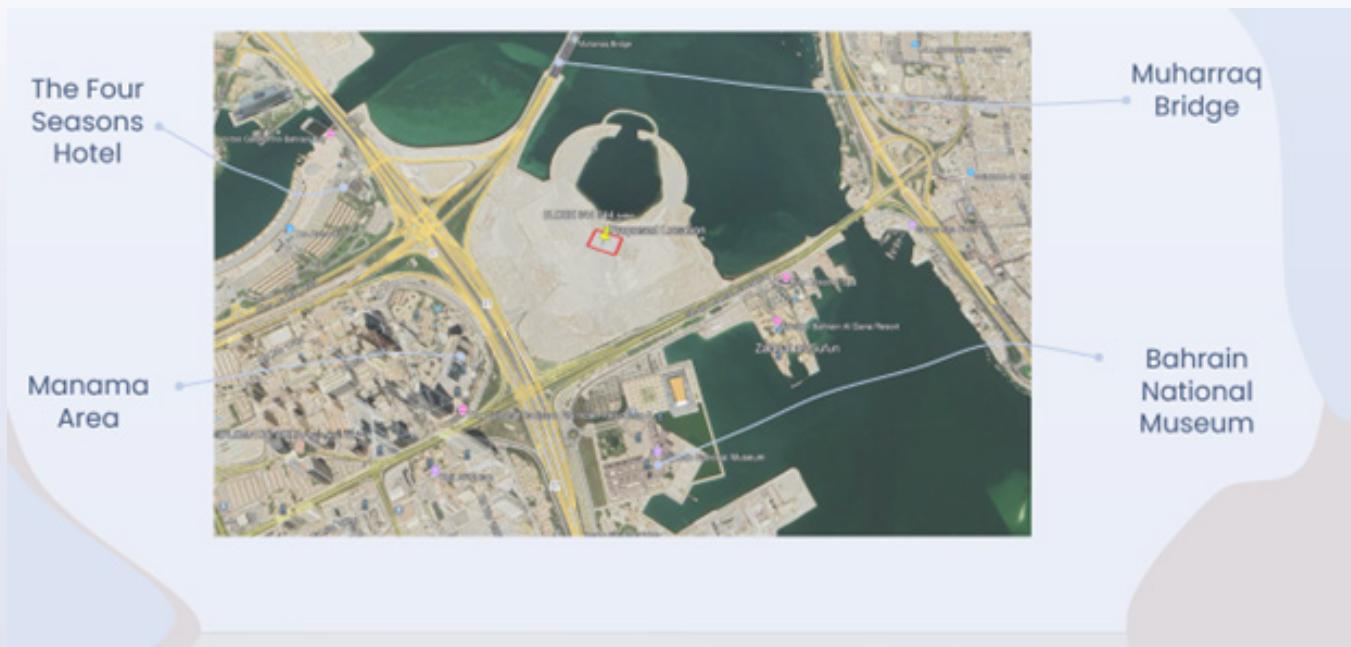
Co-supervisor: Dr. Rashid Abdulrahman

This report presents the structural design and analysis of a 28-story rotating high-rise mixed-use building located in the Diplomatic Area of Manama. The design addresses the challenges posed by dynamic and rotating loads through the implementation of a cantilever structure, achieving a balance between architectural innovation and structural efficiency while complying with the American Concrete Institute (ACI) Code for reinforced concrete structures.

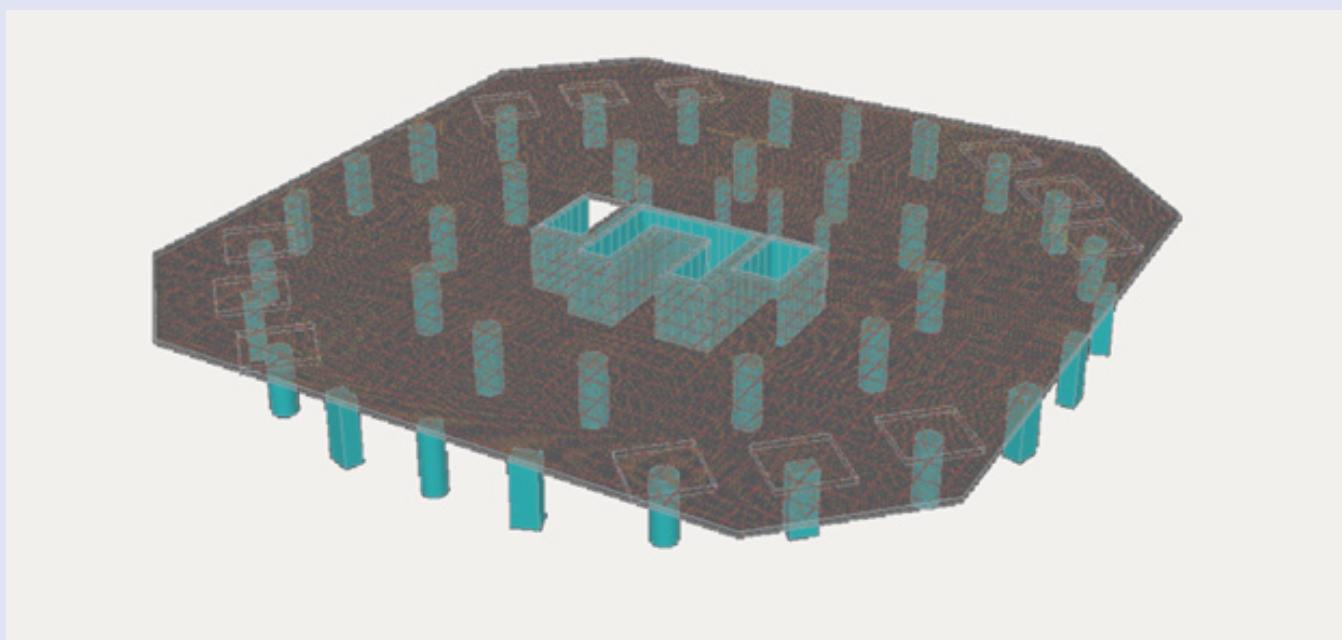
Key structural components, such as slabs, columns, and beams, were designed and analyzed using AutoCAD, ETABS, and RAM Concept, while the foundation design was carried out using SAFE software to ensure stability under static and dynamic forces. ETABS provided a detailed assessment of the building's resistance to

wind forces, and AutoCAD was used for precise layouts and drawings. Additionally, a 3D model was created in SketchUp to support the architectural visualization of the project.

The project also includes the design of an access road, incorporating a roundabout and horizontal curve connections. This was developed using Civil 3D, ensuring optimal functionality and efficient traffic flow. Sustainability measures were integrated by installing solar panels on parking shade structures, enabling renewable energy generation. The solar panel system was designed to align with the parking layout and Manama's climate, ensuring consistent year-round performance and reducing the building's carbon footprint.



Project site



Post-pressure slab design

4

Electrical and Electronic Engineering

Design and Implementation of a Smart off-Grid PV System

Place: 2nd

Students: Abdel Rahman Fuad Musleh

Yusuf Hani Almoadhen

Supervisor: Dr. Zouhir Khalifa Bahri - University of Bahrain

The project presents the design, simulation, and validation of an intelligent off-grid solar Photovoltaic (PV) system intended to assure continuity of supply for critical loads in remote environments. Conventional energy solutions, such as diesel generators, offer reliability but are environmentally harmful and costly to operate. On the other hand, solar energy systems, while sustainable and cost-effective in the long term, are challenged by their dependence on sunlight, which makes them unpredictable. A key challenge in off-grid solar systems is ensuring uninterrupted power supply without excessively oversizing batteries, which are the most expensive component, or installing larger PV arrays, which require more physical space.

To address this challenge, a complete off-grid solar system was designed and tested using real-time digital simulation. The system incorporates a decision-based control strategy designed to prioritize essential loads and shed non-essential ones during periods of limited energy availability. Real-time weather data, including solar irradiance and cell temperature, was retrieved from the Solcast platform through its Application

Programming Interface (API) and transmitted to the Real-Time Simulation Computer-Aided Design (RSCAD) simulation environment through a Transmission Control Protocol/Internet Protocol (TCP/IP) connection using Python. Forecasted weather data, obtained through the same API request, was used by the Python-based control algorithm to predict energy availability and make informed load shedding decisions.

The system was validated under different scenarios, including clear days, nighttime, and rainy conditions. Results showed that the system was consistently able to maintain power to essential loads even under worst-case conditions. During normal weather, non-essential loads were also supplied when this did not risk the availability of energy for critical loads. The novelty of this project lies in its real-time, data-driven control framework, which improves upon prior efforts that depend on offline simulations, synthetic weather inputs, and fixed load profiles. This work also aligns closely with Bahrain's vision as it directly supports Sustainable Development Goal 7, which emphasizes access to affordable, reliable, and clean energy for all.

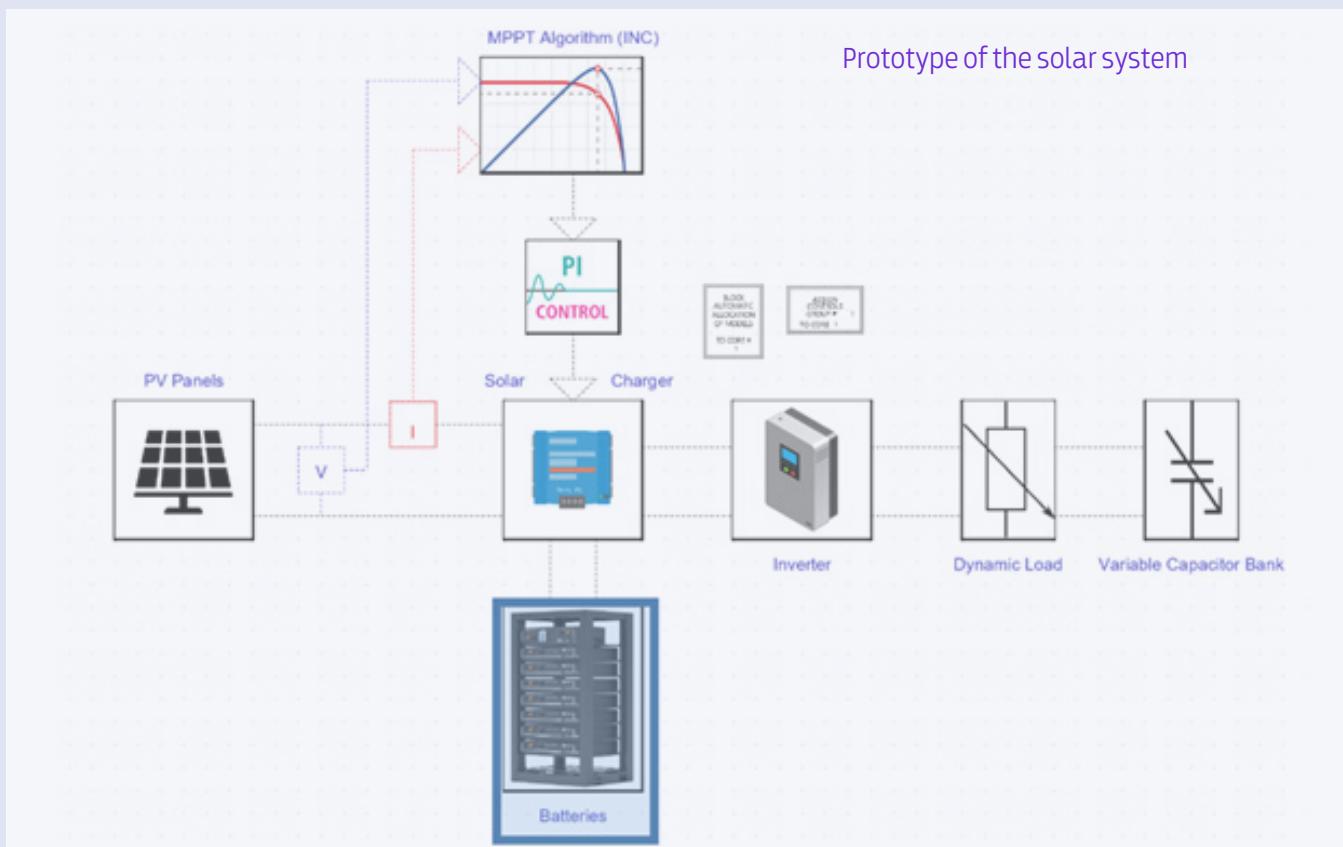


Prototype vs. Real-Time
Simulation



Solar system Prototype

NovaCor RTDS



Implementing the system in the Real-Time Computer-Aided Design (RSCAD) simulation software

5

Mechanical Engineering

Autonomous Oil Skimmer Boat with A Self-Sustaining System for Surface Oil Spill Recovery

Place: 1st

Student: Fatema Mohamed Al Jowder

Supervisor: Dr. Mohammed Abdulrazaq - University of Northampton

This project presents the design and development of an Autonomous Oil Skimmer Boat that provides a smart, sustainable, and scalable solution for surface oil spill recovery. It addresses the inefficiencies of traditional oil cleanup methods, which are typically slow, labor-intensive, and energy-dependent, by introducing a self-sustaining, solar-powered system capable of independent operation.

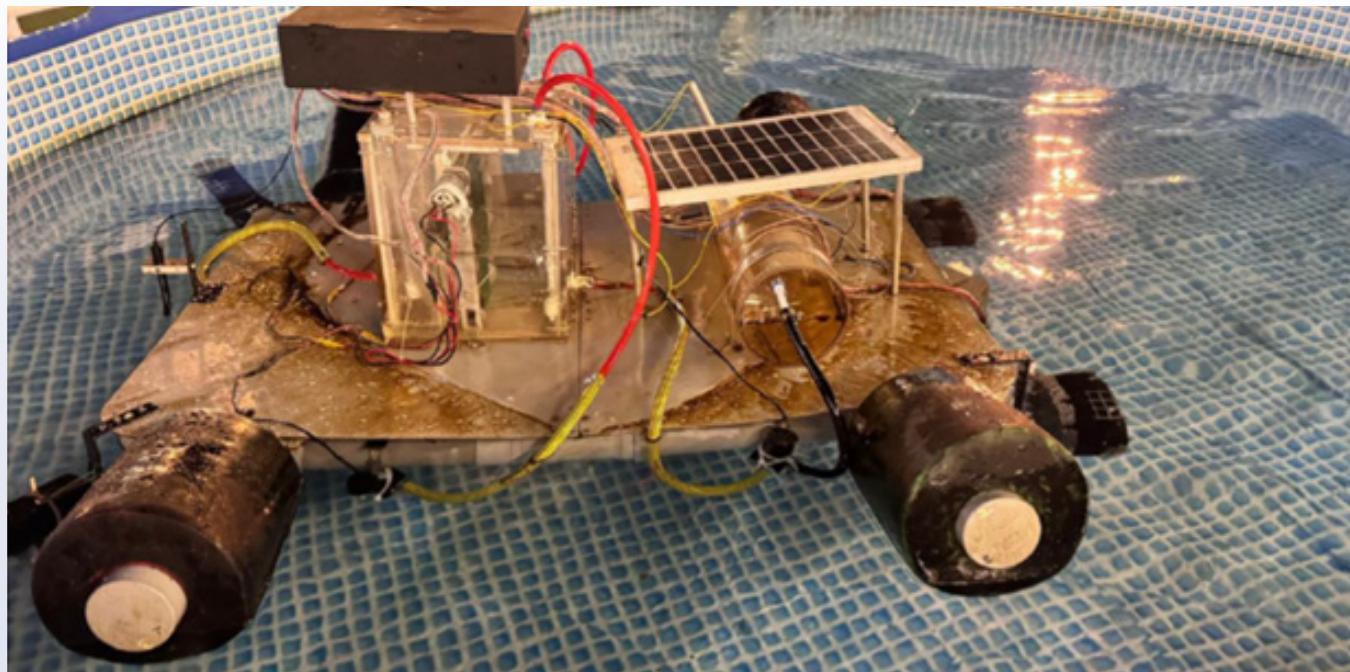
At its core, the system uses an ESP32-CAM module programmed to process live video feeds and detect oil spills through pixel color thresholding within a defined Region of Interest (ROI). Upon detection, the system activates a belt-driven skimmer and relay-controlled pumps to collect and discharge oil. Simultaneously, alerts and real-time status updates are transmitted via the Blynk IoT platform, enabling users to monitor system parameters, manually override controls, and access live video through a mobile interface.

Power autonomy is achieved through a 25W solar panel coupled with a solar voltage sensing circuit that continuously monitors and regulates energy input, allowing off-grid operation. The boat's propulsion system—driven by BLDC motors and controlled through an L298N driver—provides full directional mobility for

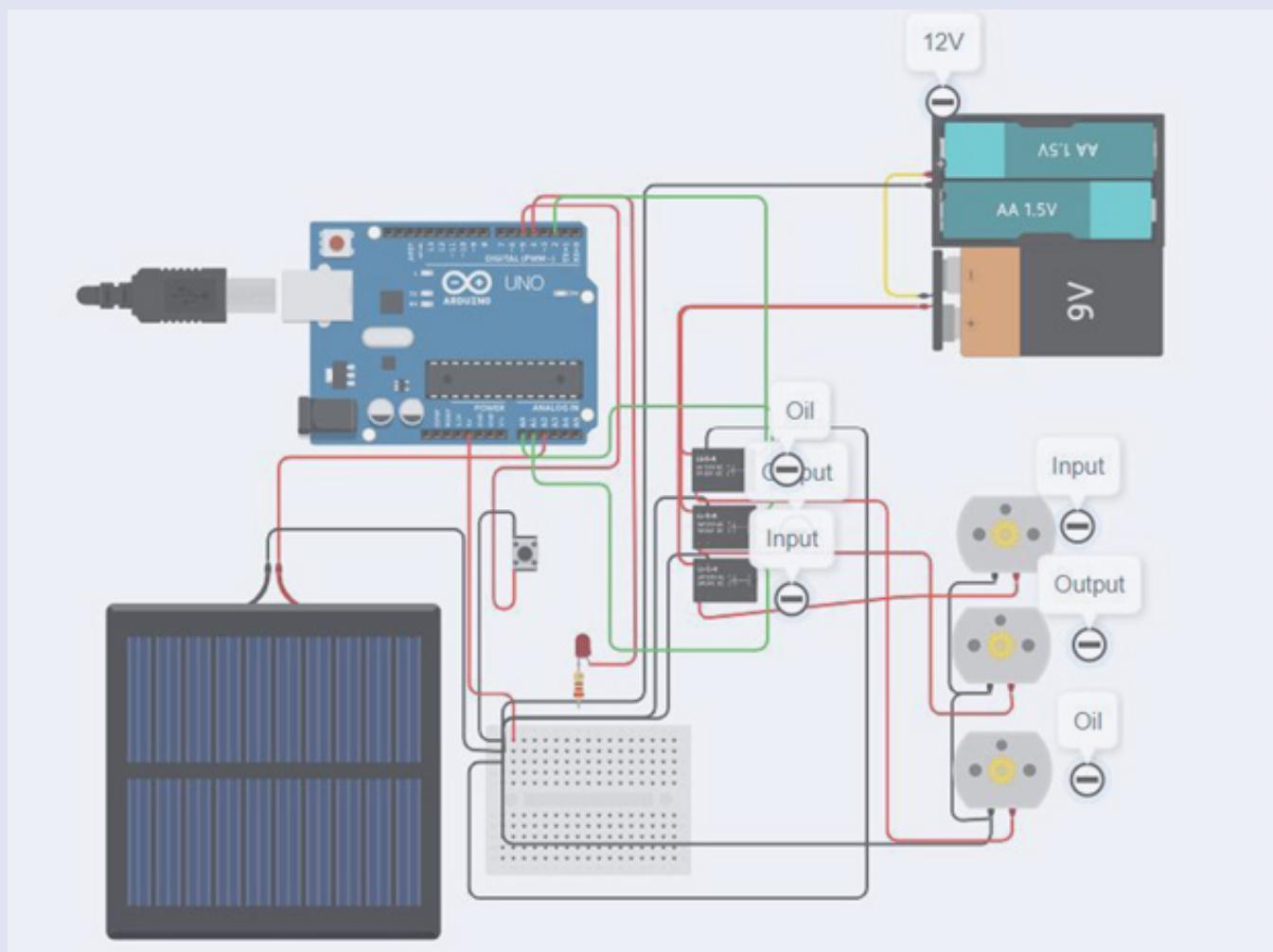
efficient navigation across contaminated surfaces. The mechanical design, modeled using SolidWorks, ensures both functional integration and waterproofing of all electronic components.

The system also incorporates a pH sensor for real-time environmental feedback, offering insights into water quality and pollution severity. Ethical design considerations include secure image handling and minimized environmental disruption. During testing, the prototype achieved over 85% detection accuracy, demonstrating high responsiveness, energy efficiency, and robust autonomous performance.

This integrated solution aligns with multiple United Nations Sustainable Development Goals (SDGs 6, 7, 9, 12, 13, and 14), supporting clean water, renewable energy, responsible consumption, and climate action. With its low cost, compact structure, and modular scalability, the project serves as a viable prototype for future developments in autonomous marine cleanup systems. Potential enhancements include GPS-based navigation, AI-driven oil classification, and multi-vessel coordination for large-scale environmental recovery operations.



A boat collected oil spills during testing



Internet of Things (IoT) circuit and pie chart



Dr. Fawzi ALJawder
Senior IEEE Member
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Floating PhotoVoltaic Power Stations

As the transition towards clean and renewable energy continues to grow, innovative and reliable solutions are vital to overcoming the challenges of using renewable energy sources. Floating PhotoVoltaic Power Station (FPV) is one of the promising innovative solutions to address space constraints and improve energy conversion efficiency, particularly, in land-poor and water-rich regions. There are many advantages to FPV power stations compared to land-based PV power stations, which are discussed in the literature [1-5]. This article explains the basic operating principles and presents a comparison between land-based and FPV power stations.

1. Main components

1-Main components of FPV power stations

Fig. 1 shows the main components of a FPV power station [1]. The FPV power station consists mainly of PV arrays, a DC-to-AC Inverter, a Floating platform, Anchoring and Mooring Systems, Protection system, Cables and a transformer.

1-PV Array: This is the component which converts the sunlight into electrical power. The most common PV panels, used for FPV power stations, are crystalline silicon panels [2]. These modules perform efficiently in a salty environment. The panels, which are installed on the floating structure, can be floated on lakes, rivers and in maritime areas that are not

subjected to high wind speed or waves.

2-DC-to-AC Inverter: The inverter is the power electronics device which converts the DC electrical power into AC electrical power. In addition, it synchronized the PV power station with the grid for grid-connected PV power stations. In single-stage PV power stations, the inverter also acts as a maximum power tracker (MPPT). On the other hand, in two-stage PV power stations, a DC-to-DC converter is placed between the PV array and DC-to-AC inverter to track the maximum PV output power at different irradiance and temperature levels.

3- Floating Platforms: The floating platform, used for FPV power stations, is a pontoon structure. The pontoon structure is made of a high-density polyethylene which has Ultraviolet

(UV) resistant, corrosion resistant, maintenance free, recyclable and having good tensile strength [2]. Other floating structure options include glass fiber reinforced plastic and galvanized steel platforms and one or two axis tracking platforms.

4- Anchoring and Mooring Systems: The anchoring and mooring systems are required to hold the system in place and avoid overturning or floating away as depicted in Fig.1.

5-Protection system: The protection system of the FPV power station comprises surge

protection devices (SPDs), Circuit breakers and fuses. Surge protection devices (SPDs), which are placed in open water areas, protect against lightning strikes and voltage spikes. Circuit breakers and fuses are used to prevent damage from overcurrent and short circuits in both DC and AC circuits.

6-Cables and Transformer: Cables are used to transmit the produced electrical power to the grid/load center whereas the transformer is used to step up the AC voltage and connect the FPV power station to the grid.

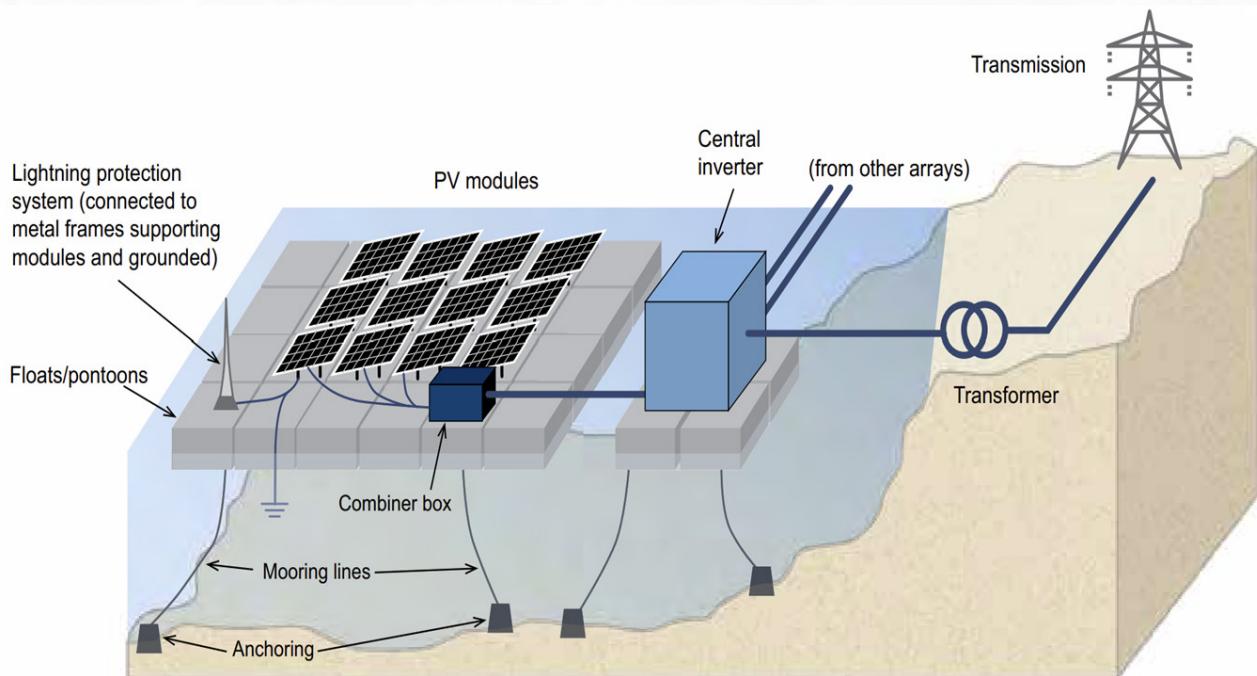


Fig.1 FPV power station [1].

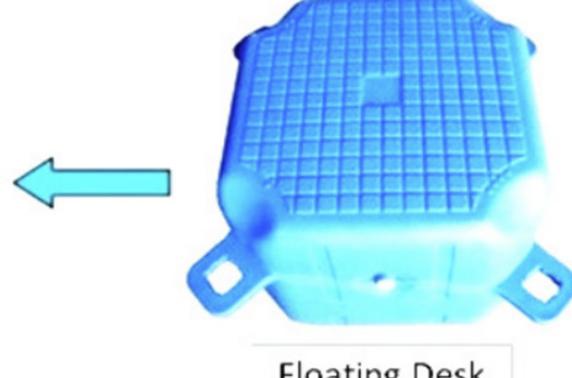
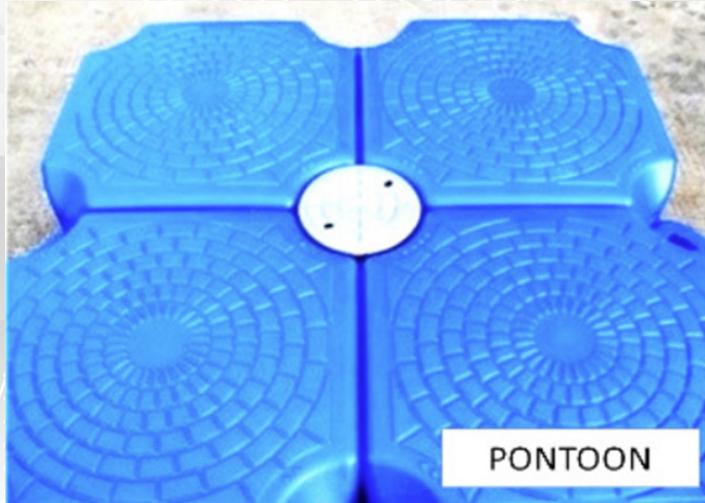


Fig.2 High-density polyethylene [3].

2-Comparison between land-based and Floating PV power stations

Table 1 shows a comparison between land-based and Floating PV power stations in terms of

installation platforms, efficiency, installation and maintenance costs, environmental and ecological impact and market potential [1,2].

Table 1. Comparison between Land-based and FPV power stations.

No	Difference	Land-Based PV power stations	FPV power stations
1	Installation platform	<p>Installed on the ground and have the following advantages and limitations:</p> <p>-Advantages</p> <p>1-Well-established infrastructure and design models.</p> <p>2-Easier access for construction, installing and maintenance.</p> <p>3-Compatible with single-axis or dual-axis tracking systems to increase captured PV power.</p> <p>-Limitations</p> <p>1-Requires large land areas, which can lead to competition for land with city dwellings, industrial development, and agriculture and requires change in land use, which can be time consuming.</p>	<p>Installed on the lakes and reservoir on floating platform and have the following advantages and limitations:</p> <p>Advantages:</p> <p>1-Use unexploited water surfaces, preserving valuable land and therefore no need for land acquisition or costly site preparation which reduces the upfront cost.</p> <p>2-Decreases water evaporation in reservoirs by shading the water surfaces.</p> <p>3-water cools PV panels which can improve PV panel efficiency.</p> <p>Limitations:</p> <p>1-Requires floating platform to handle waves, water level fluctuations, and mooring.</p> <p>2-Site availability is limited to suitable, calm water bodies.</p>
2	Efficiency	<p>1-Performance is normally consistent and predictable.</p> <p>2-May suffer from heat buildup because of limited natural cooling, which slightly reduces efficiency.</p>	<p>1-The cooling effect of water can improve panel efficiency by 5–15% compared to land-based systems [5].</p> <p>2-The reflective surface of water (albedo effect) can also increase solar irradiance under certain conditions.</p>
3	Installation and Maintenance cost	<p>1-Less expensive to install and maintain due to easier access and well-developed technology.</p> <p>2-Cost advantages of scale have driven down costs significantly in recent years.</p>	<p>1-Typically, 10–20% more expensive due to floating platforms, anchoring, and waterproof electrical components [6].</p> <p>2-Maintenance can be more complex due to difficult access and potential biological fouling.</p>
4	Environmental and Ecological Impact	<p>1-Potential environmental impact includes habitat disruption and soil degradation.</p> <p>2-Can lead to conflict with agricultural and residential land use</p>	<p>1-Lower land footprint makes them environmentally favorable in terms of land conservation.</p> <p>2-Disruption to aquatic ecosystems, reduced light penetration, and degraded water quality without appropriate controls.</p>
5	Market Potential	<p>1-Highly scalable.</p> <p>2-widely adopted around the world, especially in land-rich regions.</p>	<p>1-Fastest-growing markets, notably in regions where land is limited.</p> <p>2-Suitable for hybrid systems, particularly when combined with hydroelectric reservoirs.</p>

3- Challenges, Limitations and Mitigation Strategies.

There are operational, environmental and social challenges associated with development, installation and operation of FPV power stations which must be addressed properly to ensure sustainable and reliable operation. These challenges depend on FPV power station size, the technology employed, site characteristics, and other municipality and environmental regulations. In this section, a brief explanation of some of these challenges and mitigation strategies is presented.

1-High Initial Cost: Floating structures, corrosion-resistant materials, and underwater cabling increase capital expenses by 10–25% [6] compared to land-based PV power stations, though costs are declining [7].

Mitigation:

- 1-Use standardized modular floating platforms to maximize economies of scale.
- 2-Floating PV power stations can combine with existing hydropower station infrastructure to share transmission costs.
- 3- Produce floating structures locally to reduce transportation costs.

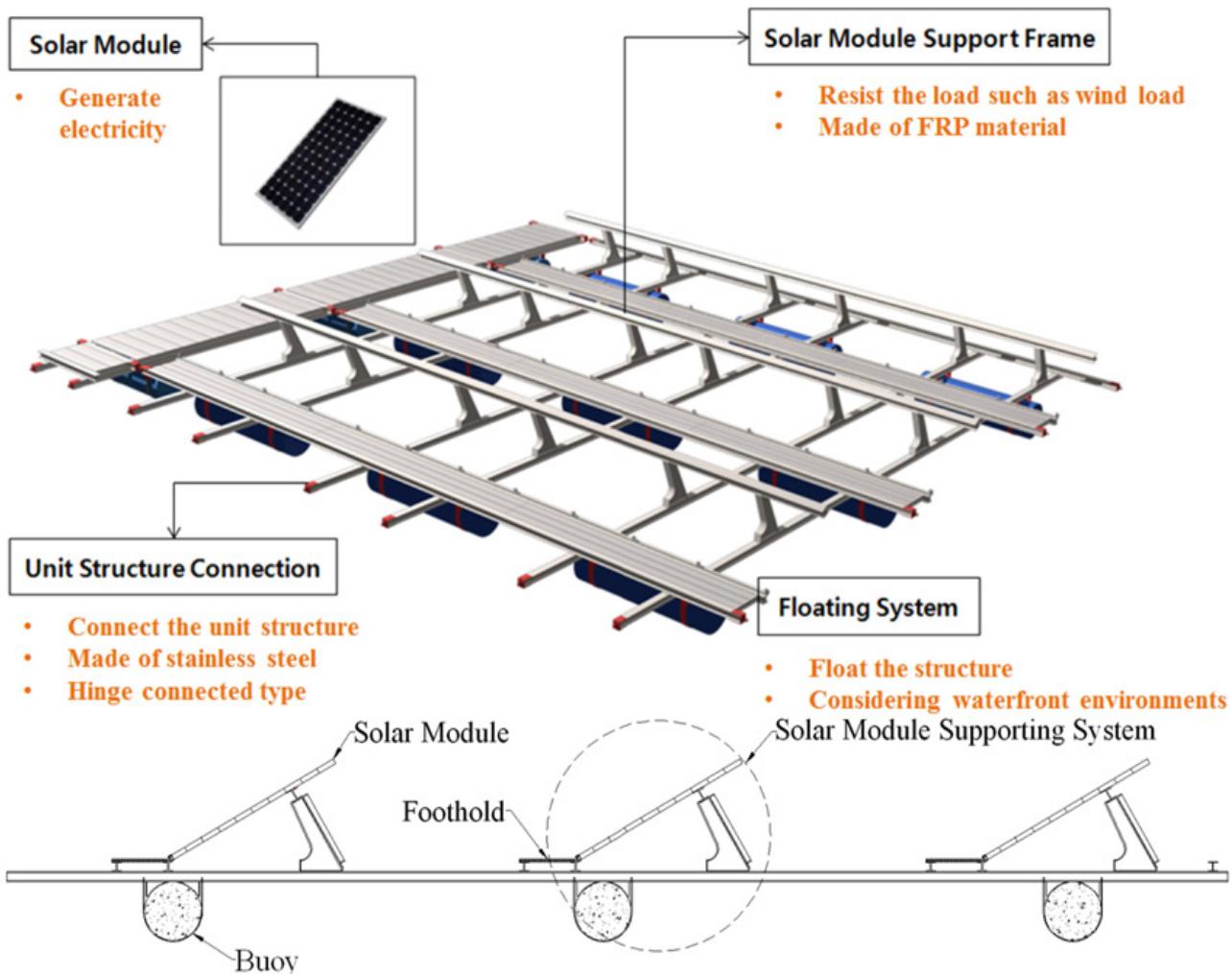


Fig.3 Fiber Reinforced Plastic (FRP) [4].



2-Environmental Concerns: Environmental concerns include reduced sunlight penetration, which harms aquatic photosynthesis and modifies ecosystems and potentially harm fish and underwater plants [8]. In addition, chemical leakage from low-quality materials may pollute water, particularly in drinking reservoirs.

Mitigation:

1-Design PV arrays with gaps to permit sunlight penetration and preserve migration paths for aquatic fauna.

2-Use lead-free components and non-toxic float materials to avoid water pollution.

3-Install a water quality monitoring system to detect harmful changes and optimize operations in response.

3-Durability & Maintenance: Floating PV power stations are exposed to water, humidity, and Ultra Violet (UV) radiation which accelerates corrosion of metal components. In addition, high waves, high wind speed, and biological fouling place significant stress on mooring systems

and floating structures. Furthermore, routine maintenance is challenging due to limited accessibility, safety hazards for personnel, and the requirement for specialized equipment.

Mitigation:

1-Advanced corrosion-resistant materials such as galvanized steel, aluminum alloys, and polymer composites can be utilized for floating structures and electrical components.

2-Using anti-fouling coatings and UV-resistant materials can contribute to extending the lifespan of the system.

2-Drone Inspections can be employed to detect hotspots and anomalies to eliminate the need for physical access.

3-Automated cleaning systems can be deployed to minimize human exposure to dangerous environments.

4-Multiple access walkways can be installed in opposite directions to facilitate emergency evacuation. In addition, workers must hold valid certifications (boating licenses, swimming

proficiency), wear proper PPE (life vests), and have access to on-site rescue boats.

4-Electrical Safety: The presence of both water and electricity creates serious shock risks, and high humidity can cause insulation deterioration and potential short circuits

Mitigation:

1-National Electrical Code (NEC) requirements for wet locations, including proper grounding, bonding, and use of watertight enclosures must be complied.

2-Regular and frequent maintenance and insulation resistance tests must be conducted to identify potential leakage paths before they become hazardous.

3-Detecting ground faults devices and ensuring proper grounding system are crucial to preventing dangerous leakage currents.

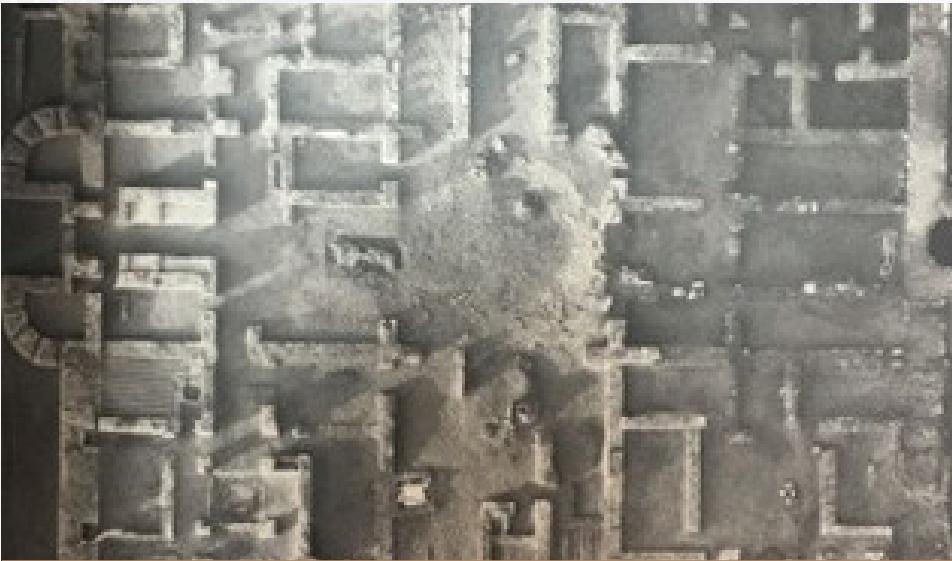
4-World First and Largest Floating PhotoVoltaic Power Stations (FPV)

The world's first FPV power station is installed in Aichi Province in Japan in 2007 which is rated at 20 kW [9,10]. The main purpose of this power station was to supply power to local residents. Fig.4 shows the FPV power station in Aichi Province in Japan.

Fig.5 shows the world largest FPV power station which is installed in Dezhou, China in 2022. The FPV power station is rated at 320MW and connected to 8Mhr of battery storage and a 100MW wind farm.

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Heritage Documentation

Articles



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This article is a summary of a research paper that was published by the author, reporting on using Virtual Reality (VR) in heritage documentation, particularly Bahrain Fort site, Figure 1.

Digitalization has become crucial for heritage preservation, yet VR—despite its acknowledged potential for providing high-fidelity immersion—remains underutilized in documenting complex architectural heritage. This article addresses this gap by investigating various 3D digitalization methods and introducing a novel framework for using VR to effectively document and archive archaeological sites, specifically focusing on the chronological changes that occur over extended periods.

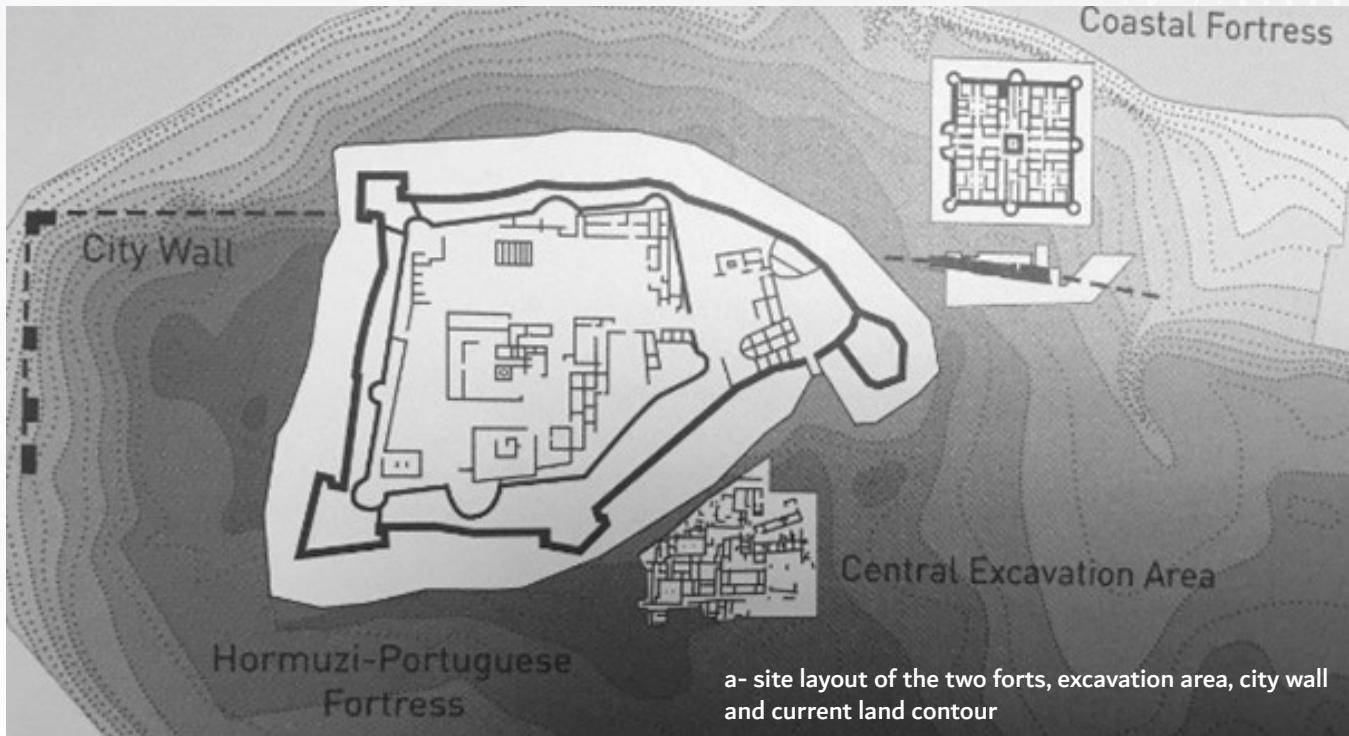
The article reviews established digitalization techniques, noting that 3D digital reconstruction offers precision superior to traditional drawings. Key methods explored include:

- **Virtual Reality (VR):** Offers advantages such as high geometric accuracy, photorealism, low cost, portability, and application flexibility. VR models enhance the user's experience through interaction and immersion.
- **Building Information Modelling (BIM):** Investigated as a management tool for the heritage life cycle (tangible and intangible). When combined with tools like Navisworks, BIM provides 4D time simulation to document chronological changes.
- **Augmented Reality (AR) & Gaming:** Successful

applications, such as the ARCO system and various gaming concepts, demonstrate the potential for creating web-based virtual museum exhibitions and immersive learning tours.

- **Active vs. Passive Technology:** Active 3D technology delivers full HD resolution, while passive technology (like polarized glasses) offers a cost-effective, stereoscopic immersion.

The article focuses on a 5000-year-old archaeological site in Bahrain, the capital of the Dilmun civilization and a UNESCO World Heritage site, characterized by seven stratified layers, different topographical terrains, and various architectural structures (including the Portuguese Fort and the Coastal Fort). This complexity requires a unique documentation approach.



a- site layout of the two forts, excavation area, city wall and current land contour

The core framework involves creating new VR functions within the VR platform (VR Studio) to enable multiple chronological narratives inside a single model.

1. Modeling and Data: Due to the lack of original CAD drawings, the model was constructed using the 3ds Max program, based on detailed historical documents, photos, and diagrams from official

archives.

2. Novel Function: The proposed VR function uses XML programming within the VR Studio's microsimulation feature to control the visibility of model sub-components (terrains and monument parts) based on two key variables: time (chronological order) and location (spatial coordinates).

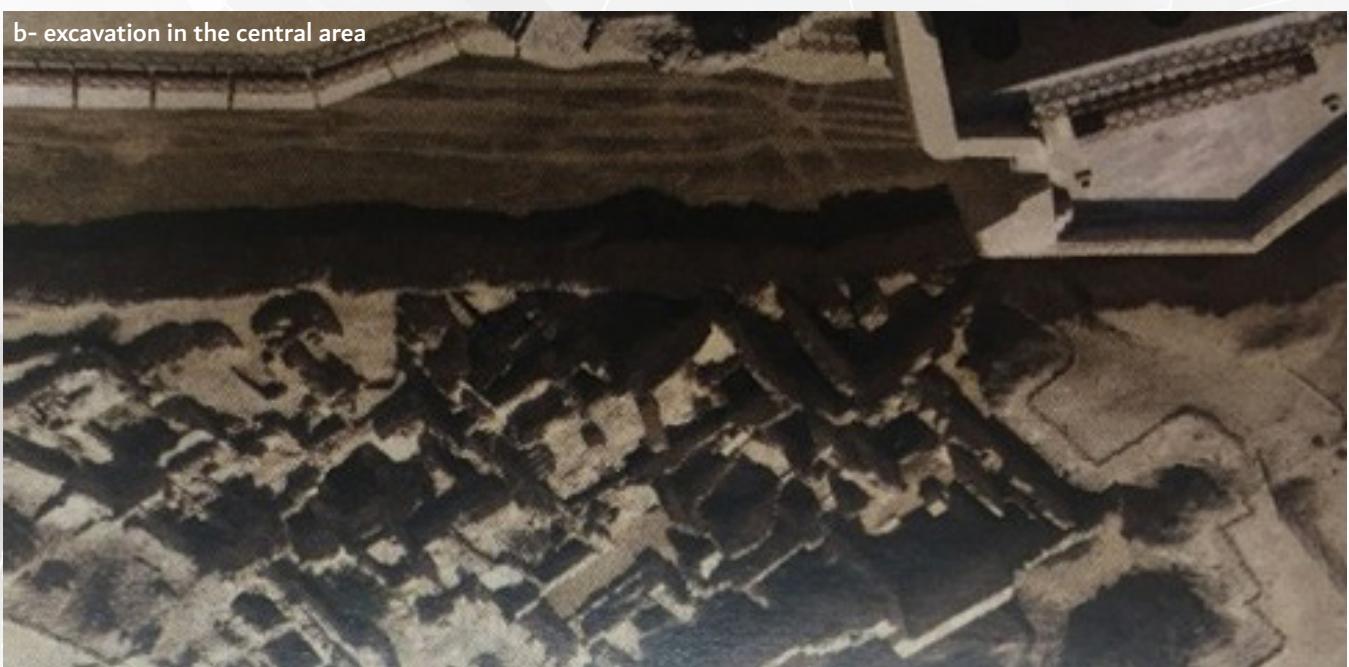


Figure 1, main structures of the archaeological site, during excavation (a), and reconstruction (from Ministry of Culture publications, Bahrain)

3. User Experience: The system allows the user to visualize the chronological stages of excavation and reconstruction—from the site being almost buried to its current state. At any chronological point, the user can pause the visualization process and freely navigate or walkthrough the model.

The article demonstrates the feasibility of constructing a highly interactive and chronologically precise VR model for complex architectural heritage. This new VR function, based on time and location controls, provides a powerful tool for archival, documentation, and visualization, Figure 2.

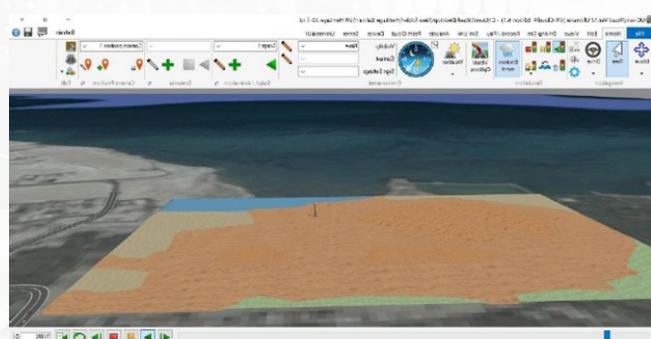
The findings highlight significant potential applications, including:

The article demonstrates the feasibility of constructing a highly interactive and

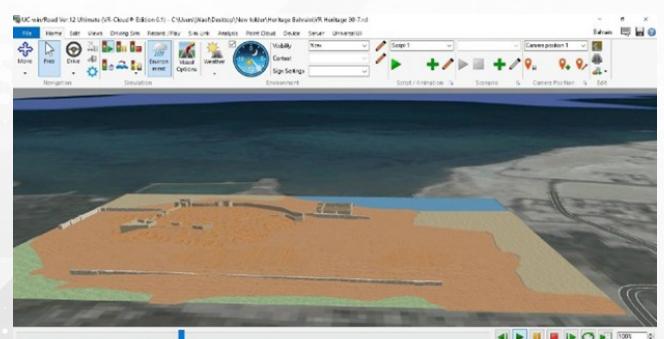
chronologically precise VR model for complex architectural heritage. This new VR function, based on time and location controls, provides a powerful tool for archival, documentation, and visualization, Figure 2.

The findings highlight significant potential applications, including:

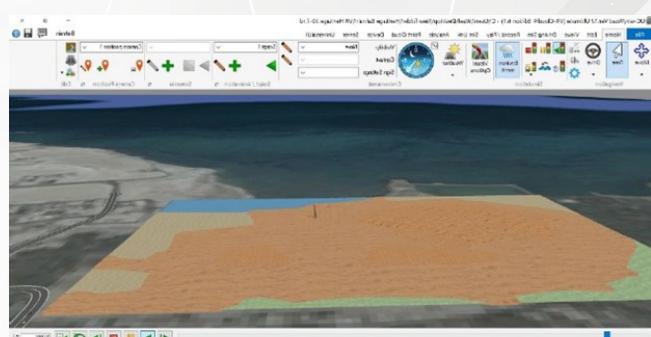
- Creating a robust platform for archiving vast amounts of historical metadata (text, photos, videos).
- Developing highly effective educational tools and virtual cultural heritage tours.
- Enabling deeper understanding and analysis of built forms and techniques used across different historical periods.



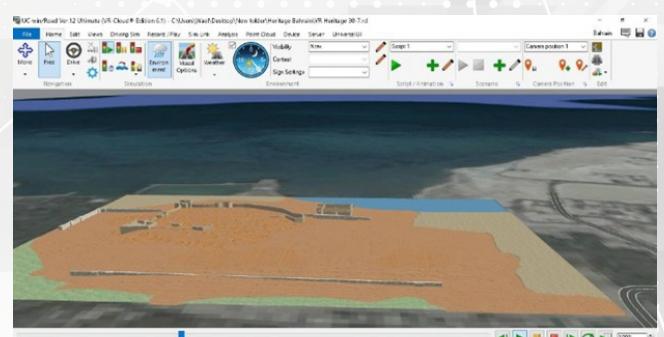
a- the archaeological site before excavation



b- during excavation processes



c- during reconstruction processes



d- zoom in to show the two forts and central

Figure 2, VR model of the archaeological site showing its main structures, (made by the author.)



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Submission

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Camera - Ready
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Projects

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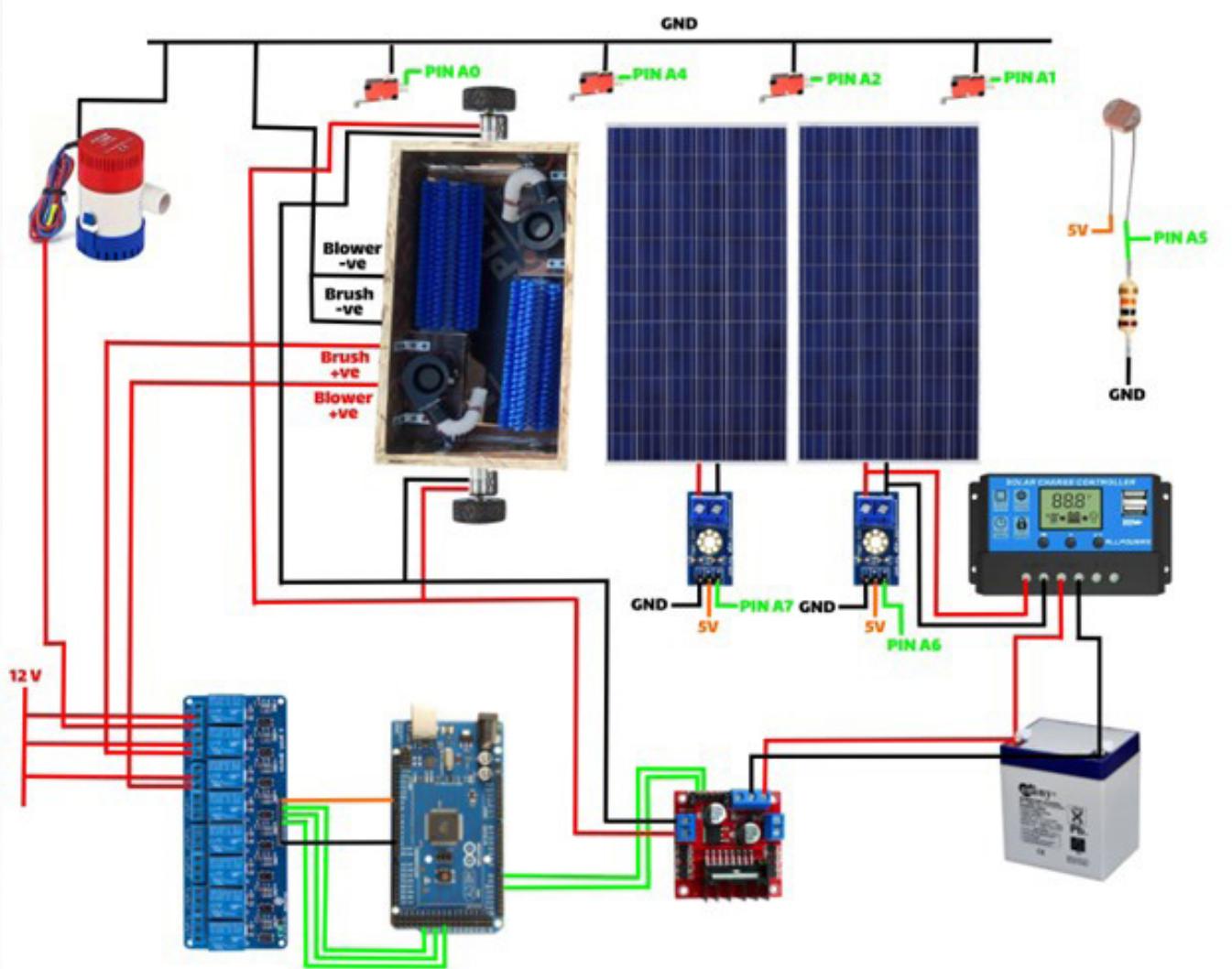
Department of Electrical & Electronics Engineering

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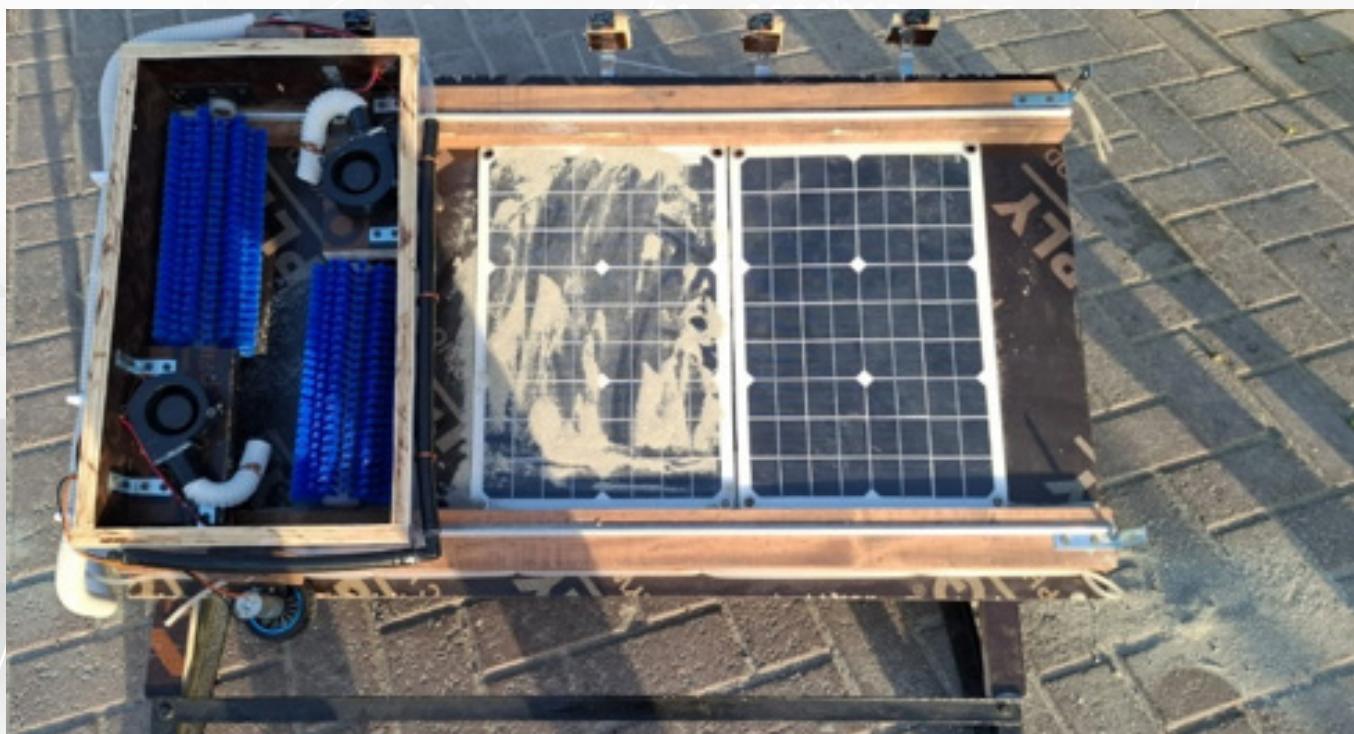
Optimizing Solar Panel Performance with Targeted Cleaning

Solar power is one of the complementary sources of renewable energy, as its sustainability, low operating costs, and environmental benefits speak in its favor. Dust, sand, bird droppings, and other contaminants on solar panels will seriously impact their performance areas that are most arid and dusty. Research shows dirt buildup that can lower solar panel output by between 10% and 30%, so regular cleaning is needed to ensure maximum performance. Conventional cleaning methods are usually inefficient, very labor-intensive, and are a massive waste of precious water and energy because all the panels are cleaned in the same way irrespective of their mixed condition.

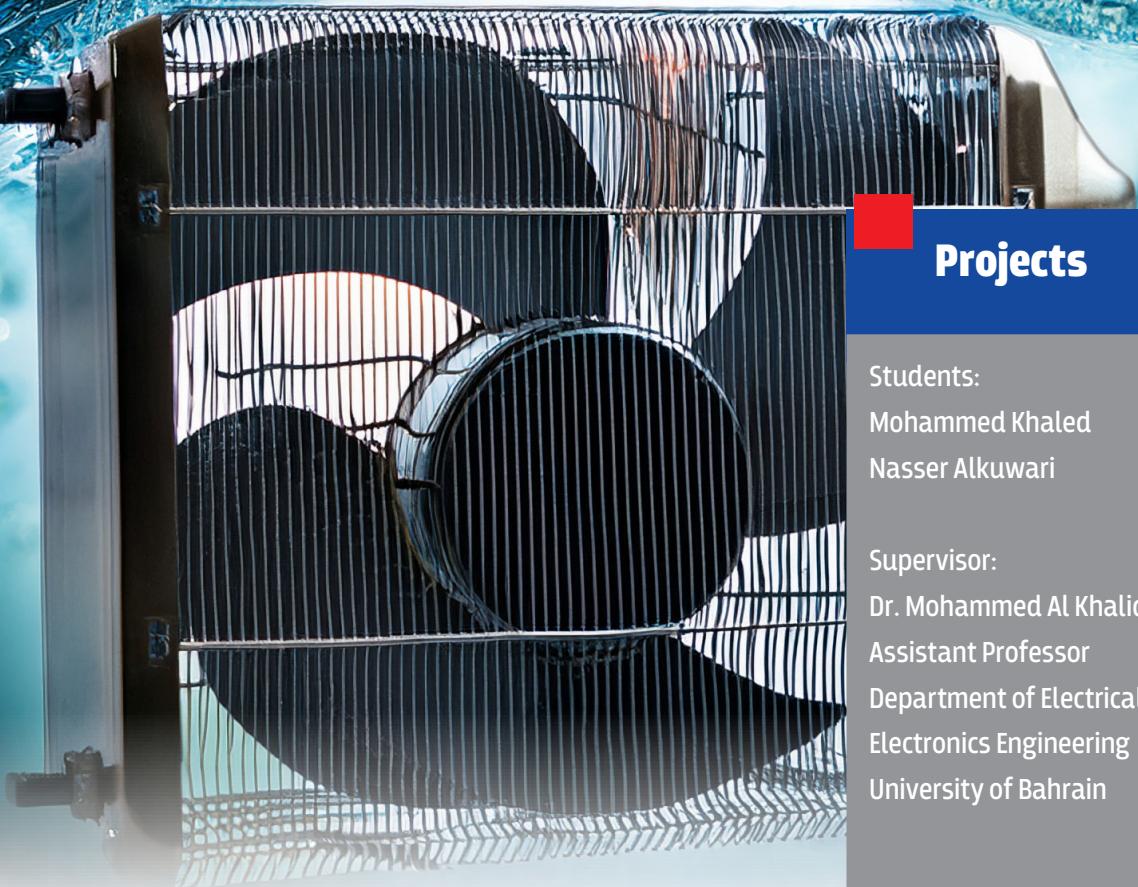
The main idea centers on an intelligent, targeted solar panel cleaning system to promote energy generation and reduce operational expenses. The system measures from each panel voltage output at its central base through the voltage sensor. Those panels failing to reach a certain level of desired performance are declared dirty. A mobile robot-go-anywhere cleaning unit is then unleashed to clean only the dirty panels using a rotating brush and pressurized water. The cleaning robot again makes several passes and then moves backward one step toward a fresh measurement of the cleaned panel without going back to base in case the measured value still falls within the dirty range; the cleaning robot



Electrical and Electronic Circuit Design



Solar Panel Project



Projects

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Water Cooling by using Radiator Fan

Effective thermal management is essential to maximize the utilization and safety of stored water, especially in hot regions where rooftop water tanks can become extremely hot. Conventional cooling systems frequently fail, prompting the creation of a low-cost, high-efficiency, automated replacement. This project depicts the design, construction, and testing of a smart water-cooling system that includes an Arduino-based controller, temperature sensors, a car radiator, a pump, and cooling fans. The system continuously monitors the water temperature and activates cooling mechanisms when set limits are exceeded, achieving suitable water temperatures with minimal human intervention.

The project was built within economic, operational, environmental, and safety constraints, resulting in a cost-effective and energy-efficient design.

It focused on immediate response, sustainability through water recycling, and compliance with international standards such as IEC 60529 and ISO 9001:2015. Extensive testing demonstrated that the system operates efficiently by effectively reducing water temperatures and maintaining stability over extended periods of operation. Challenges encountered during the implementation phase, such as sensor calibration and relay interference, were effectively overcome to ensure system reliability.

This work presents a realistic and scalable alternative for residential and small industrial applications requiring efficient water-cooling. Future additions could include Internet of Things (IoT) technologies for remote monitoring and control, as well as the use of solar energy to increase the system's sustainability. The



success of this project demonstrates the potential for using smart, low-cost thermal control devices to improve living conditions and contribute to energy conservation efforts in hot climates.



Cooling fan and radiator





Projects

Students:

Aalaa Abdulali Alahmad

Yusuf Ali Albasri

Ebtihal Abduljalil Alhaddad

Supervisor:

Prof. Mohab Mangoud

Professor

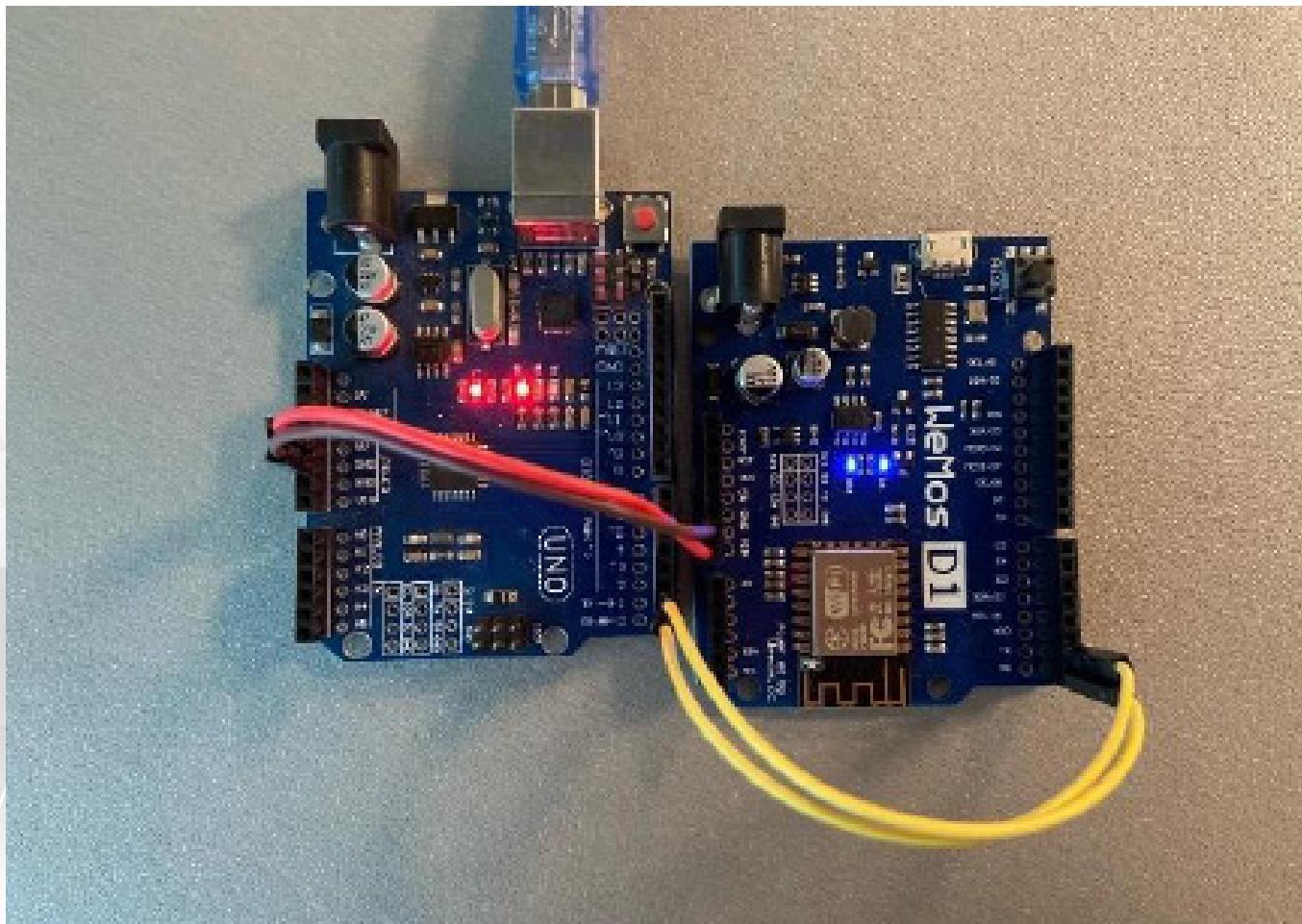
Department of Electrical &
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University of Bahrain

Autonomous Agricultural Robot for Precision Pesticide Spraying and Field Navigation (AgriTech-Rover)

The AgriTech-Rover project focuses on developing an autonomous vehicle designed to enhance agricultural practices through targeted pesticide application. By integrating advanced computer vision, IoT technology, and microcontroller systems, our vehicle effectively detects plants using a Roboflow-trained AI model with YOLO, allowing for precise pesticide spraying only where necessary. This approach minimizes waste, reduces environmental impact, and enhances farmer safety by mitigating health risks associated with pesticide exposure. The system employs a combination of WeMos D1 R2 (ESP8266) and Arduino Uno microcontrollers,

ensuring efficient operation across diverse agricultural environments. Through rigorous testing and implementation, the AgriTech-Rover demonstrates significant potential for real-world applications in modern agriculture, paving the way for future advancements in agricultural technology and promoting sustainable farming practices. This report outlines the project's design, development, and successful outcomes, highlighting its importance in addressing critical challenges in the agricultural sector.

The final product, «Agri-Tech Rover,» is a self-driving vehicle using artificial intelligence.



Reception and transmission



Projects

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Speed Monitoring System

This project details the design, implementation, and evaluation of a Speed Monitoring System aimed at enhancing road safety by dynamically detecting and enforcing speed limits. The project addresses the critical issue of over-speeding, a leading cause of road accidents, by providing a real-time, automated solution for speed monitoring and alerting.

The system integrates GPS technology, IoT connectivity, and an ESP32 microcontroller to calculate real-time vehicle speeds using an IR speed sensor. By incorporating predefined geographical zones with specific speed thresholds, the system ensures dynamic speed enforcement tailored to the surrounding environment. Violations are

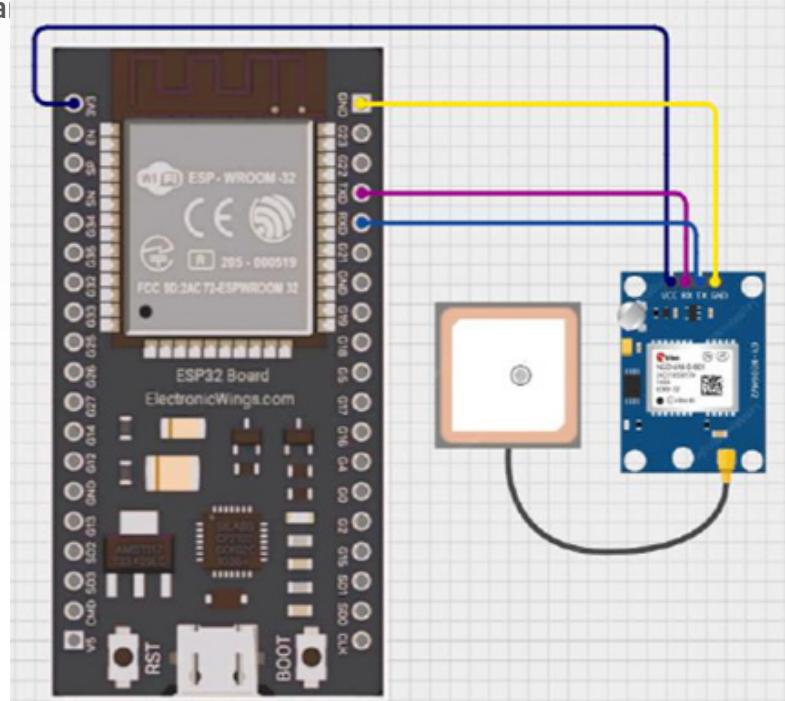
identified promptly, with real-time notifications sent to users via the Blynk mobile platform and immediate feedback displayed on an integrated LCD interface.

The development process included meticulous hardware selection, such as the ESP32 microcontroller, IR speed sensor, GPS module, and I2C LCD display, alongside modular software development for efficient data processing and task management. Extensive testing was conducted under controlled conditions, evaluating system accuracy in speed calculation, zone detection, and alert generation.

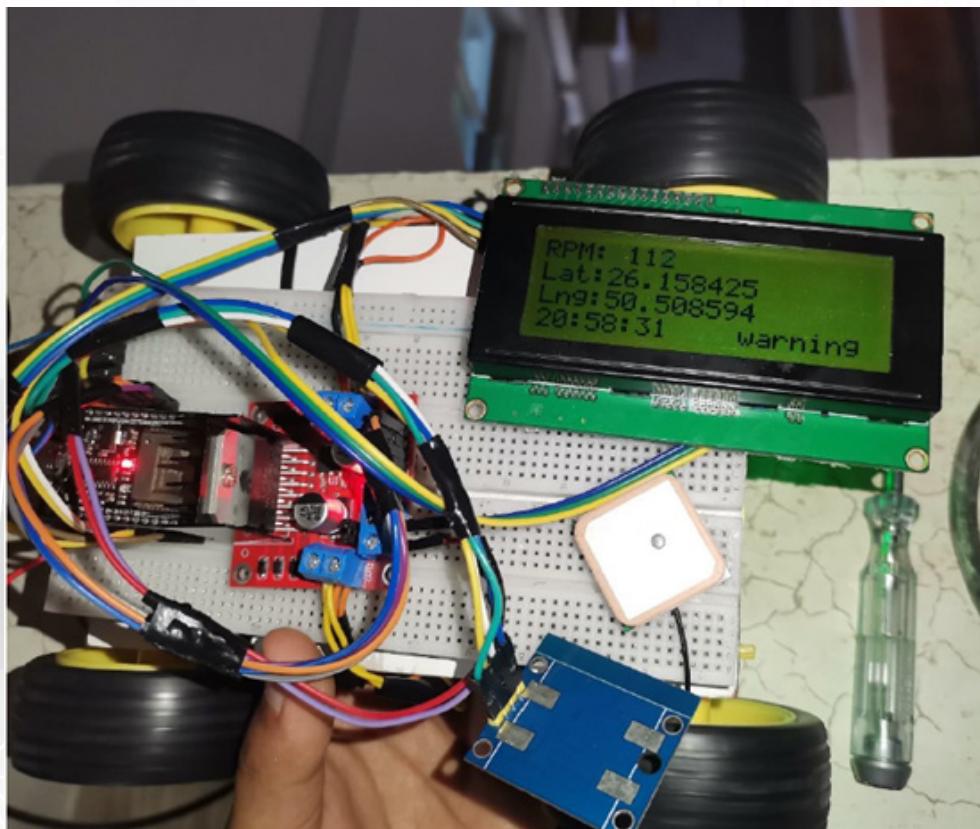
The results demonstrated the system's capability to deliver reliable performance, including high

accuracy in speed detection and effective user notifications. Limitations, such as environmental interferences like poor GPS signal in urban areas, were identified and provide a basis for future improvements. Potential enhancements include improving environmental resilience, optimizing battery efficiency, and integrating advanced analytics to predict high-risk zones.

Overall, this Speed Monitoring System offers a scalable, cost-efficient, and practical tool for improving traffic management and safety.



Global Positioning System (GPS) unit



Liquid crystal display (LCD) outputs



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