



MECHATASTIC

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A Publication of **Department of Mechatronics & Control Engineering**
University of Engineering and Technology, Lahore
Powered by Mechatronics Club, UET Lahore.



DR. ALI RAZA

CHAIRMAN MECHATRONICS & CONTROL ENGINEERING DEPARTMENT

Opportunities emerge whenever ideas merge! Mechatronics & Control Engineering is one prime example where countless opportunities have emerged by combining the fields of mechanical and electronics engineering. Be it an industrial robot handling tough workload on a shop-floor, day in and day out, or an autonomous car delivering pizzas during COVID lock-down, mechatronics manifests itself in different ways. If we are able to further add a little bit of product-designing with a pinch of entrepreneurship, we may be able to produce engineers which can solve real-world problems or make innovative products. This is where we, at the department of Mechatronics & Control Engineering, are aiming to push the current academic program. Whether we are doing well or not, but all the courses, all the labs and all the efforts are oriented towards equipping our engineers with tools and skills to excel in the everchanging field of mechatronics.

But this whole effort will remain futile, if we miss the most necessary ingredient i.e., the human-centric approach. This may act like a binder. This may provide a purpose to Mechatronics & Control Engineering. It means that our graduates should be able to connect with their people, observe their needs, understand real-world engineering problems, and then contribute professionally to make their life better.

I believe that the Mechatronics Club in general, and this magazine in particular, can provide this human-centric vision to its members and readers. I wish you luck.



MR. MISBAH UR REHMAN MR. M. RZI ABBAS

DIRECTORS MECHATRONICS CLUB

Mechatronics club was formed with a vision to provide students with opportunities beyond curricular activities. Back in 2008, a dire need for such a platform, dedicated to the students of the Mechatronics & Control Engineering department, was felt. Since then, the family of Mechatronics Club has helped hundreds of students achieve something extra that will go a long way in their professional and personal lives.

The Club itself has evolved both on the managerial side and on the technical side. A strong management team, well-organized events, and participation in national and international competitions are some things that we are proud of. All this was achievable because one main ingredient is the commitment that the members show towards the Club.

We believe Mechatronics Club is an outsider looking at and the first impression a fresh student gets is through this platform. This puts much pressure on our shoulders to maintain the standards of everything we are involved in. Therefore, compliance with the statutes of the Club is never compromised.

To ensure the continuous growth of the Club, its members, and the department of Mechatronics & Control Engineering we believe in giving opportunities and responsibility of leadership to some of the best students. Moreover, the sense of competition to reach the top in the hierarchy pushes students to their limits and allows them to evolve into better students and people.

I would end the note by inviting you to come forward and join us to unlock your managerial and technical potential.



AHMAD ALVI

PRESIDENT MECHATRONICS CLUB

Mechatronics Club promotes the advancement of Mechatronics & Control Engineering and emerging technologies to facilitate the global narrative of scientific discovery, development, and sustainability as they are the entire enterprise. International collaboration and constructive discussion of ideas within talented individuals are essential to advancement.

We aim to bridge the divide between capable inquisitive young minds and flourishing opportunities to cultivate and inspire a culture of impactful research and innovative critical thinking at both a national and international level. We look forward to facilitating and empowering youth potential in realizing cutting edge ideas and unique initiatives in the effort of shaping a more positively advanced and permanently sustainable world embodying the principles of transparency, teamwork, and communication in the name of mutual benefit and growth.

MEET THE TEAM



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Documentation Team

ACKNOWLEDGMENT

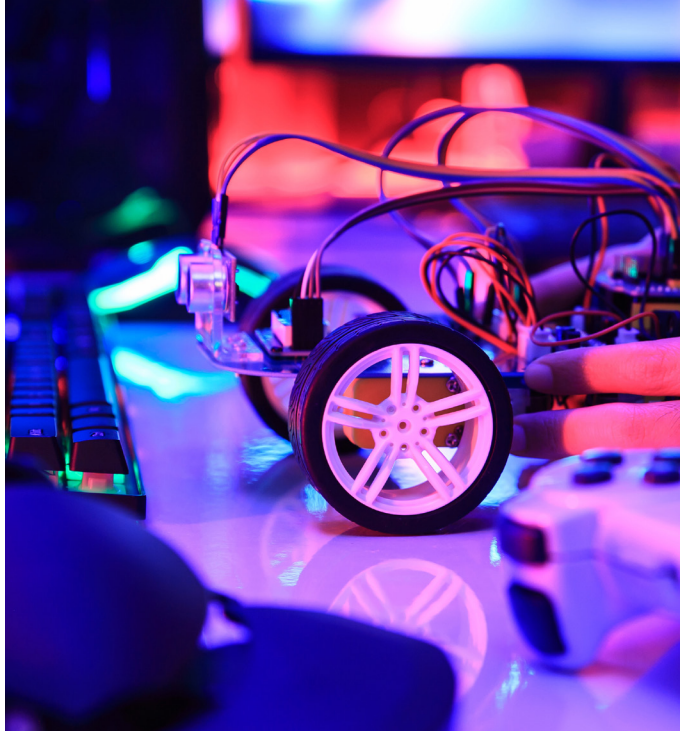
We would like to take this moment to express profound gratitude to our worthy Chairman Dr. Ali Raza for his valuable suggestions, and our highly talented and co-operative Directors Mr. Misbah Ur Rehman and Mr. Muhammad Rzi Abbas to produce the first magazine of Mechatronics & Control Engineering department. Their mentorship and guidance has been a very useful resource throughout this journey. We would also like to thank the senior leadership of the Mechatronics Club, our worthy President and the Core Body. We are grateful to them for their consistent support, guidance and assistance in compiling resources necessary to complete the magazine.

At the end, we would like to dedicate a special thanks to worthy members of the Mechatronics & Control Engineering Department and the Mechatronics club who worked as volunteers in the magazine team. The shining stars of the magazine team include Mian Husnain Akram from House Keeping team, Abdurrehman Sarwar from Management team, Ali Sajid from Technical team, M.Noor Sultan from General Event Activities team, and Ali Ahmed, Atif Riaz, M. Taha Qazi and M. Faizan Tanveer from Documentation team. We are indebted to you for your services and support

Momna Tahir

Director Human Resource
Team

TABLE OF CONTENTS



OUR HISTORY

8 Department and Club

Founding

OUR MISSION

9 Mechatronics Club Mission

Clubs Core Values

MECHATRONICS ENGINEERING

10 Insight to Mechatronics Engineering

LABS & PROJECTS

13 Academic Strength

Research Domains

Research Labs and On-going
Projects at Departments

14 Hydraulics & Pneumatics Lab

Embedded Systems Lab

Control & Instrumentation Lab

15 AI and Robotics Lab

Automation Lab

Power Electronics Lab

16 Human-Centered Robotics Lab

Mechatronics Research
Simulator for Cardio- Pulmonary
Resuscitation(CRP)

17 Collaborative Robot

Cardiopulmonary Resuscitation

Motion Capture

PUBLICATIONS

18 Publications of the years 2019-2021

MECHATASTIC

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Facebook : @MechatronicClubUET

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MECHATRONICS CLUB EVENTS

19 Events & Competition

20 Workshops 2020-21'

MECHTECH

21 ROBOCOM

Industrial Tour

Collaborations

QUALISYS WORKSHOP

22 Motion Capturing & 3D Position Tracking

23 Applications

About Company

Workshop at Mechatronics & Control Engineering
Department

FINAL YEAR PROJECT

24 Telerobotic System using virtual reality

25 Pick and Place Industrial Delta Robot

Human- Machine Activity Monitoring System
using Computer Vision

26 Four Legged Companion Robot

ALUMNI ACHIEVEMENTS

27 Dr. Atif Mahboob

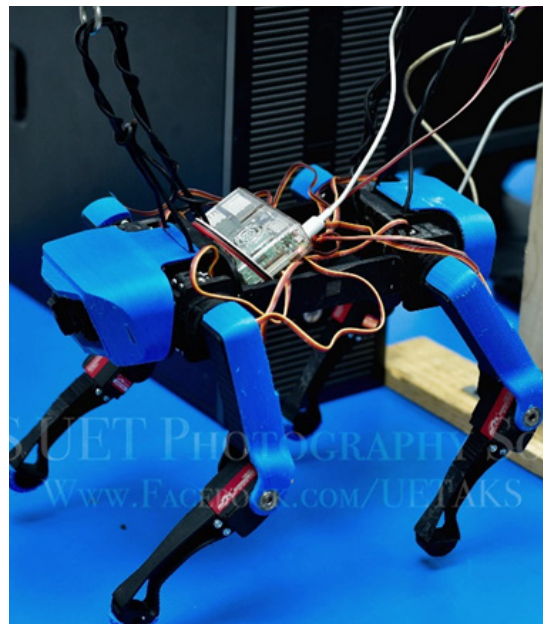
Engr. Daud Warraich

Engr. Sameen Ghaffar

OPPORTUNITIES

28 Job Opportunities for Mechatronics & Control
Engineers in Pakistan

29 Academic & Research Opportunities



MECHATASTIC
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DEPARTMENT FOUNDING

With an aspiration of developing individuals who influence the world, Mechatronics & Control Engineering was adapted as a discrete bachelors' degree program in 2001 to acclimatize to the needs of the rapidly advancing world. Back in 1999, mechatronics was offered as a postgraduate degree program at UET Lahore. The Department of Mechanical Engineering supervised the program. After its evolvement, the degree program was assigned a distinct study area in 2005; the Department of Mechatronics & Control Engineering (DMCE). Since 2005, the department has catered to the need for engineers and researchers in the Mechatronics domain. The department has successfully delivered several projects of Artificial intelligence. It has enhanced the concept and use of robotics and automation to substitute human labor and facilitate production.

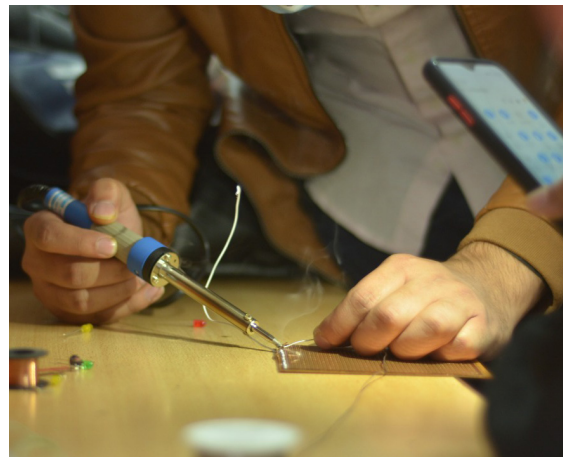


MECHATRONICS CLUB FOUNDING

As the Mechatronics & Control Engineering department grew more substantial, the faculty and the students felt a need for a platform to groom and train the students with the latest technological developments in mechatronics. The manifesto of this platform was to teach the students through workshops, seminars, competitions and prepare them for leadership roles in their professional life apart from academics. Hence, a student body named “Mechatronics Club” was formed at the Mechatronics & Control Engineering department in 2007. Since its foundation, the Mechatronics club has effectively served the purpose of imparting technological innovation and management abilities and grooming students about the developments in the domains of Mechatronics. Alumni of the Mechatronics club and Mechatronics & Control Engineering department are successfully producing value in different occupations. Mechatronics Club is on its way to creating more gems for society under competent and experienced leadership.

MECHATRONICS CLUB'S VISION & MISSION

Our vision at Mechatronics Club is to work with students from diverse Engineering backgrounds to provide a safe and healthy learning environment for all students. We encourage student involvement and accomplishment to prepare responsible, motivated members with Problem-solving aptitude. To promote and develop life-long ties for students while creating a positive and enjoyable learning environment within the Society. To create an enhancement of Soft skills while keeping everyone technically sound. We are empowering every individual to be resourceful, respectful, and responsible lifelong learners.



OUR CORE VALUES



Merit

Recognition and reward based on individual and team efforts and hard work



Innovation

Adding positive value to Society, institution, and community initiatives



Teamwork

Mutual cooperation for the benefit of the Society, institution, and community at large.



Creativity

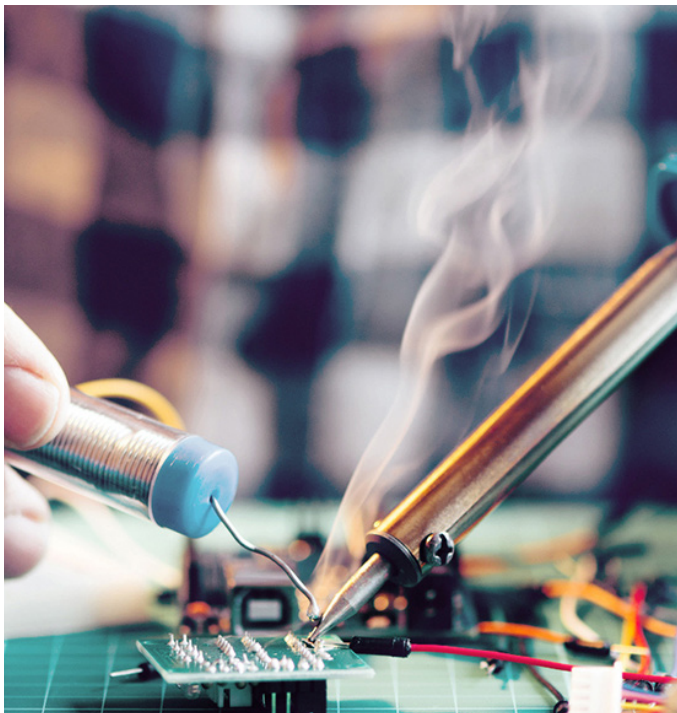
Cultivating original ideas and outside-of-the-box thinking to advance the mission of the Society.



Respect

Tolerance, acceptance of diversity, firm ethics, unwavering integrity, and openness to changey.

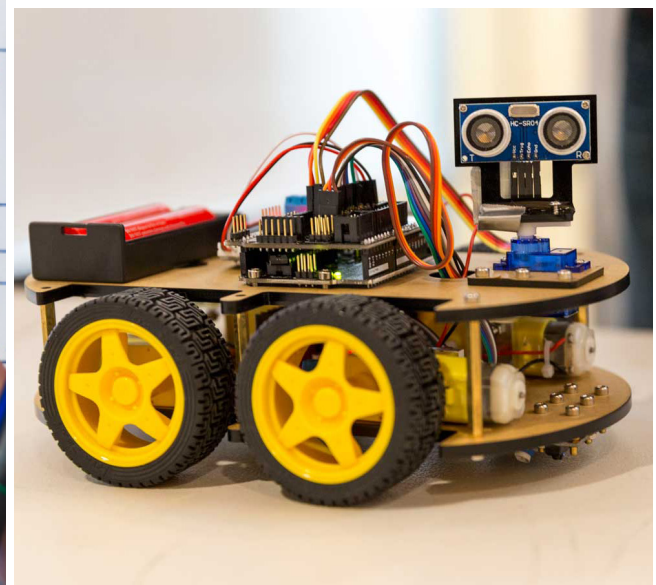
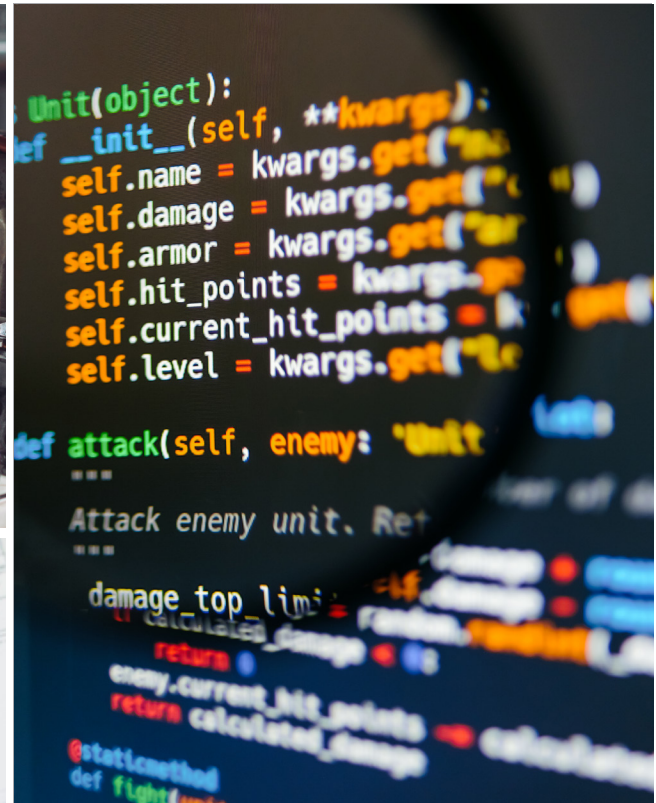
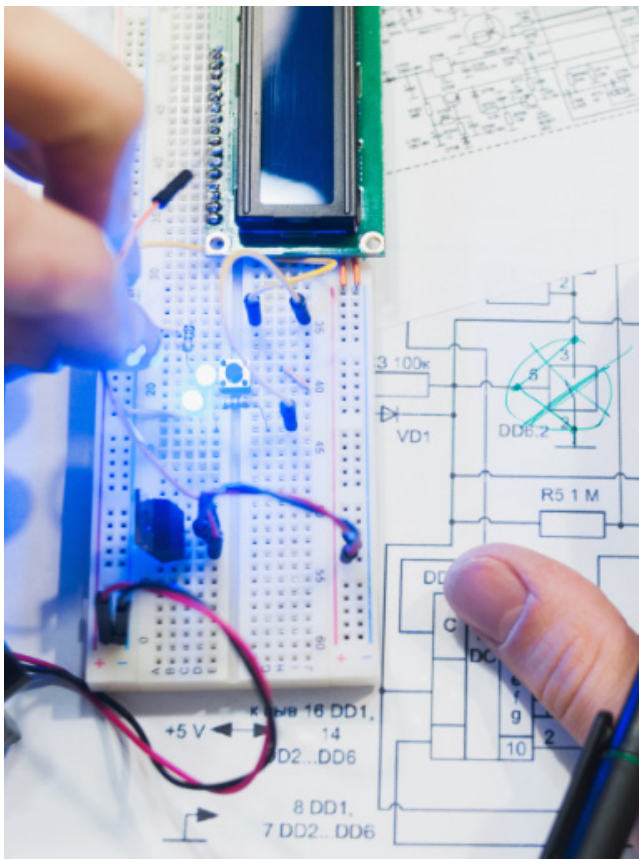
INSIGHT TO MECHATRONICS ENGINEERING



‘MECHATRONICS’ IS A MULTIDISCIPLINARY FIELD OF ENGINEERING THAT ENCOMPASSES VARIOUS TECHNOLOGICAL FIELDS LIKE MECHANICAL, ELECTRICAL, COMPUTER SCIENCE, TELECOMMUNICATION, ETC.

Have you ever thought of an engineering domain that equips you with the knowledge of the latest technologies and skills in the industry? Indeed! Mechatronics engineering can quench one’s thirst for such embedded technology. It encompasses electrical, mechanical, and computer science fields in automation, robotics, control, and artificial intelligence. Mechatronics engineering is an integrated and versatile technology that aspires to create advanced machines and devices by applying the sciences of digital control systems, control electronics, mechanics CAD, and electro-mechanics, which significantly impact the technological advancements in the world.

Mechanics and electronics are two essential features of the modern



world that commands industrial functioning and operations. Link them, and you obtain a revolutionizing concept that has become the need of the hour for the experts to understand – mechatronics. It is a comprehensive solution to manage various processes involved across multiple verticals heavily reliant on manufacturing, designing, processing, and analytics. Mechatronics is the essence of everything

in our lives. It is the bridge for the manufacturing needs of the industries, essential for the development of new products, by combining engineering in its various forms with technical and mechanical skills. This field is slowly being integrated with almost all other engineering fields to understand and modify the systems used in different areas of life. It has changed people's minds about technological advancements and has created ideas

that were impossible to think of in the past. Almost everything in our daily life has a connection with mechatronics and is progressively being enhanced to improve the quality of life for humans. To fully understand the concept of this engineering domain, one should look at the technological advancements done through this field. The following are some of the sub-branches of this versatile engineering field: Industrial robots are generally designed to perform unpleasant, repetitive, and dangerous tasks at high speeds in industrial setups. Robots also have a safeguarding system that protects other workers from hazardous conditions while working, reducing the chances of accidents. Robotics and mechatronics are playing essential roles in the development and progression of agriculture-related fields. Fer-

tilizer application, chemical spraying, crop harvesters, and robotic precision planter are agricultural areas where robots are being employed to increase crop yield. Bio-mechatronics is a field that integrates biology, mechatronics, and neuroscience. One of the main applications of biomechanics is to create prosthetic limbs for people who have a disability or have no limbs. Mechatronics engineering has saved thousands of lives by playing its role in safety gadget design such as anti-lock brakes and stabilization, airbag inflation, and fully autonomous vehicles. In this field, there is no limit to ideas. Mechatronics has an infinite number of possibilities for products which can improve our life. The only thing is to imagine what to design for people's benefit. Rest, the possibilities are endless.



LABS & PROJECTS

Academic Strength

The research focus of an institution indicates its academic strength. This intellectual strength goes a long way to determine the quality of educational products expected from such an institution. To this effect, here's the analysis of the research domain's strength of the Department of Mechatronics & Control Engineering.

Research Domains

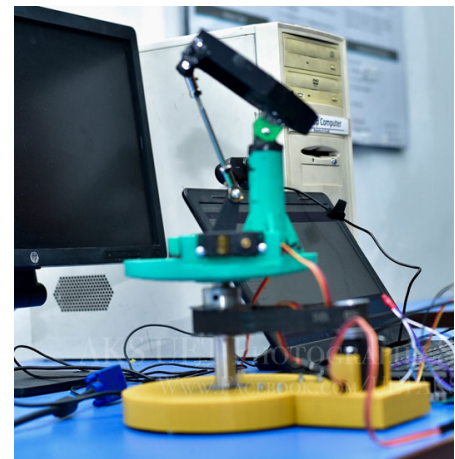
The department Mechatronics & Control Engineering is considered a Multidisciplinary department. So, we can find a Multiaxial Research hub here. As few named as:

- ▶ Micro Electro-Mechanical Systems (MEMS Modelling)
- ▶ Machine Intelligence and Artificial Intelligence
- ▶ Robotics
- ▶ Internet of Things (IoT)

Research Labs and On-going Projects at the Department

The Department of Mechatronics & Control Engineering houses different labs for its undergraduate, graduate, and doctorate students. These labs radically develop robots, programmed efficiently through stimuli and percepts without extensive reconfigurability of their hardware and software components.

Some of the notable labs along with On-going projects that are contributing to the technical development of masses are mentioned below:





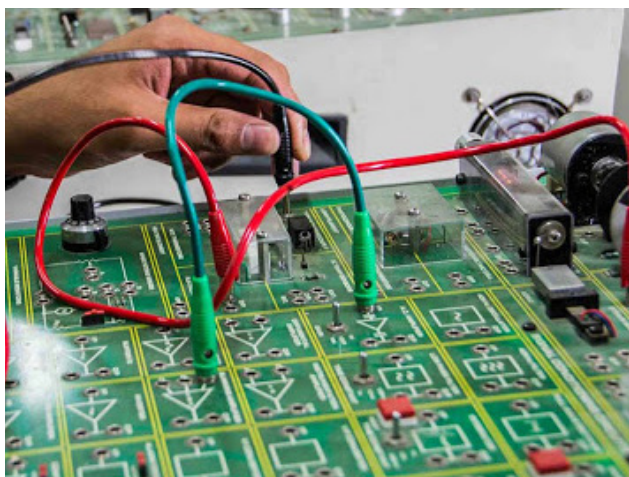
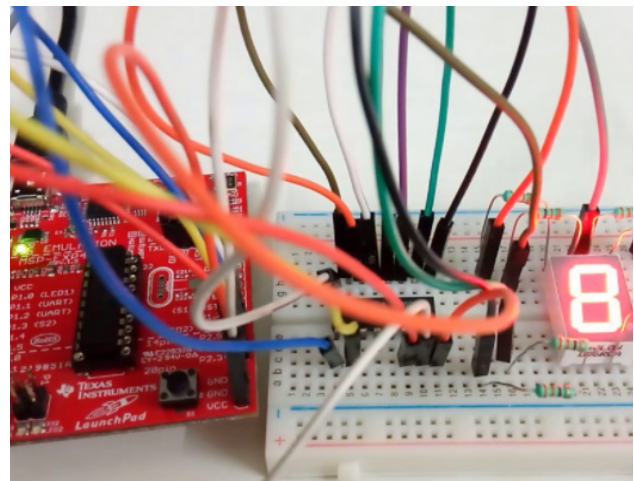
Hydraulics & Pneumatics Lab

The Hydraulics & Pneumatics lab contains various pneumatic circuits, hydraulic motors, and pneumatic valves with the advanced industrial trendy Allen Bradley PLCs hardware and software. All the equipment is well installed and efficiently programmed. This lab has advanced hydraulic systems for the manufacturing of various products and by-products.

Embedded Systems Lab

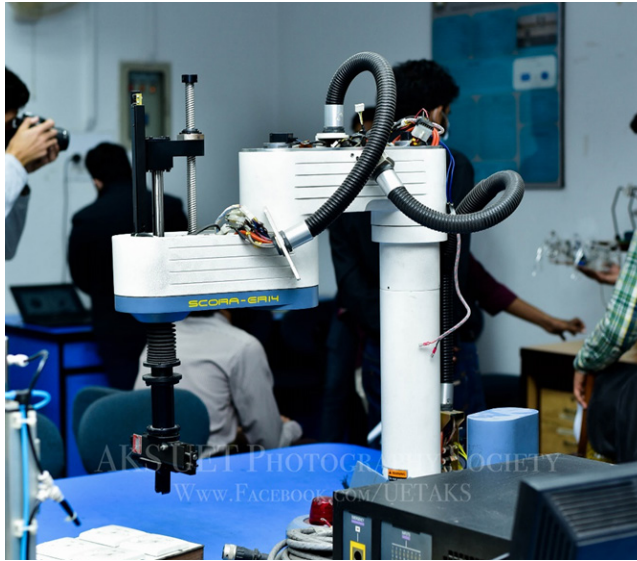
It mainly works on different multitask robots, intelligent systems, multi-link robots, multiple degrees of freedom robot and working on prostheses, and Gravity compensator.

For the Collaborative robots that allow physical interaction and synergistically share the workspace with other robots and co-workers, and to facilitate future's typical industrial applications, this lab contains intelligent robotic manipulators, Robix toolkit, Lego Mindstorms, Pitsco Tetrix Kits, and NImyRIO.



Control & Instrumentation Lab

Advanced and comprehensive instrumentation trainer DIGIAC 1750 installed in the Instrumentation lab to work and model various signal conditioning circuits and display devices with the full range of input and output transducers.

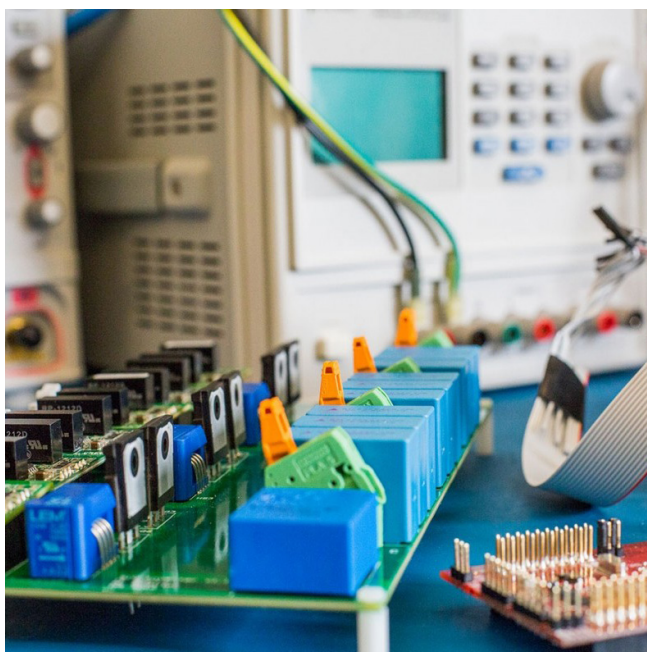
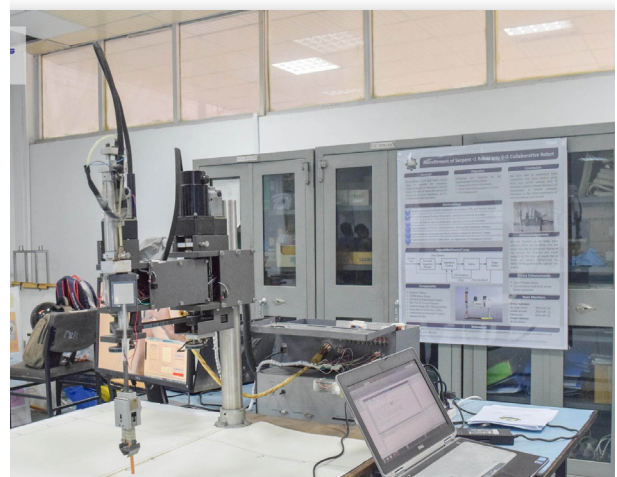


AI and Robotics Lab

Our signature lab is also establishing the first state-of-the-art gait analysis with opto-electronic system and force platforms, leading to severe multiple predicament and complications solutions. Graphics Processing Units (GPU) are installed to accelerate graphic rendering by handling various data to make it worthwhile for machine learning purposes.

Automation Lab

The Automation lab has multi-dimensional and conventional mechanism setups to enhance and check the functionality and durability of different collaborative and non-collaborative robots. Several automated robots are being designed and tested in this lab for industrial applications.



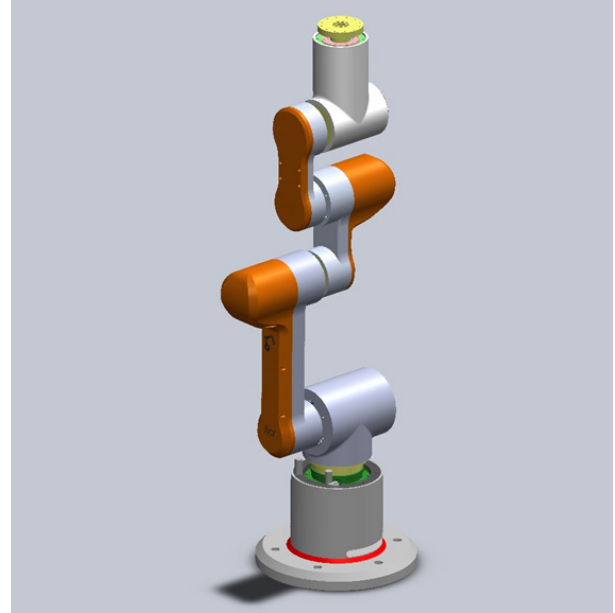
Power Electronics Lab

Power electronics lab is one of the important learning oriented labs as it houses the modern electrical and electronics components. This lab is well equipped with fast and dynamic semiconductor switching devices and other electronic components, that enable students to explore the marvels of electronic world.

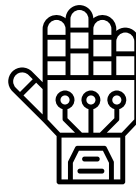
Human-Centered Robotics Lab

HCR – or Human-Centered Robotics Lab – is a part of the National Center of Robotics (NCR) and Automation. The lab aims to indigenously design and develop integrated robotic systems based on intelligent sensing and actuation to interact with humans seamlessly, actively learn from them, and eventually create an effective collaborative environment.

Human-robot interaction is at the core of our research which possesses a wide range of possibilities. Ensuing the path that will lead towards the solution of the proposed bigger problem, the following subsidiary application domains have been identified:



Collaborative Robot



Exoskeleton



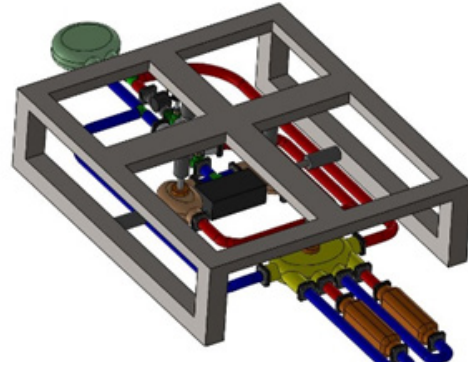
Active Prostheses

Mechatronic Research Simulator for Cardio-Pulmonary Resuscitation (CPR)

The primary objective of this pilot study is to create an exposed physical model of the human cardiovascular circulatory system relevant to CPR for investigating all possible combinations of mechanical intervention done during currently recognized methods of Cardio-pulmonary resuscitation (CPR). The research aims to find out the strategies that produce the highest Cardiac Output (COP), i.e., the best method of CPR.

The pilot phase of the “Mechatronic research simulator for CPR” is developed in a torso-less, interconnected multi-compartmental soft-skin, reservoir model mimicking six major blood compartments relevant to CPR physiology and mechanics (viz; Heart, Right lung, left lung, Abdomen, right lower limb & left lower limb). The dimensions and capacity of these organ chambers are as close to normal adult human organs as possible.

Hamad Medical Corporation is funding this project, a Qatar Public Corporation established and operating under Amiri Decree No.11/2016(hereinafter called "HMC"), having its address at P.O. Box 3050, Doha, Qatar.



Collaborative Robot

A cobot, or collaborative robot, is a robot intended for direct human-robot interaction within a shared space or where humans and robots are in close proximity. There are two designs of these robots; one has 5 Degrees of Freedom, and 2nd one has 7 DOF. It consists of joints with a Brushless DC (BLDC) motor, a high precision harmonic gear drive with min-

imum backlash, and a high-resolution optical encoder to measure the angular position. The BLDC motors are being controlled by sophisticated controllers with standard industrial motor position control architecture. The motor controllers are accessible from a Python IDE, where central control schemes are implemented.

Cardiopulmonary Resuscitation

CPR – or Cardiopulmonary Resuscitation – is an emergency lifesaving procedure performed when the heart stops beating. Immediate CPR can double or triple the chances of survival after cardiac arrest.

There are already CPR available, but their paradigm needs to be set. The primary purpose of this project is to make a Human mannequin A.K.A Simulator for CPR to check the feasibility.

Motion Capture

Mo-cap or Motion Capture - is the process of digitally recording the movement of people. It is used in entertainment, sports, medical applications, ergonomics, and robotics. In film-making and game development, it refers to recording actors' actions for animations or visual effects.

This technique uses retro-reflective markers tracked by infrared cameras, but here, markerless Motion Capture is our purpose. Earlier, it started with checking illegal bowling action but is now used widely by VFX studios, sports therapists, neuroscientists, and for validation and control of computer vision and robotics. HEC funds this project.

PUBLICATIONS OF THE YEARS 2019-2021

Research discovers, elucidates, and evaluates new knowledge, ideas, and technologies essential in driving the future of society and humanity. Without research, a relevant and modern curriculum does not exist. Research fosters professional excellence in faculty, important for delivering outstanding student education and training. To inculcate this spirit in the educational process, the

Mechatronics & Control Engineering department at UET, Lahore, values research and creativity in high regard. Every year, faculty members publish their valuable research papers and articles in esteemed and recognized international scientific journals. The following table enlists the research paper published by our faculty members from the year 2019 – 2021.

| SR NO. | AUTHORS | TITLE | JOURNAL/ CONFERENCE | YEAR |
|--------|---|---|---|------|
| 1. | I Mahmood, Ali Raza , K Arif, A Mehmood, N Ahmad | Evaluation of human brain hyperthermia using exergy balance equation | Journal of Thermal Biology, 2020 | 2020 |
| 2. | Awais Naeem, Mohsin Rizwan , Hafiz Farhan Maqbool, Muhammad Ahsan , Ali Raza , Syed Abbas Zilqurnain Naqvi | Discrete Fourier Transform based Virtual Constraint Control of Powered Ankle-Foot Prosthesis 2019 International Conference on Robotics and Automation in Industry (ICRAI) | 2019 International Conference on Robotics and Automation in Industry (ICRAI) | 2019 |
| 3. | Muhammad Bilal , Ali Raza , Mohsin Rizwan , Muhammad Ahsan , Hafiz Farhan Maqbool, Syed Abbas Zilqurnain Naqvi | Towards Rehabilitation of Mughal Era Historical Places using 7 DOF Robotic Manipulator | 2019 International Conference on Robotics and Automation in Industry (ICRAI) | 2019 |
| 4. | Jawad Hussain, Kenneth Sundaraj, Irsa Talib, Ali Raza , Priya Devi Muthusamy | Development of Simulator for Robot Assisted Surgical Platform for Cholecystectomy Training | 2019 IEEE International Conference on Signal and Image Processing Applications (ICSIPA) | 2019 |
| 5. | Ali Raza , Umair Aqil, Ummul Baneen , Muhammad Q. Saleem | Deep Foundation Testing using Immunity-based Displacement Measurement in Successive-Sparse Images | KSCE Journal of Civil Engineering | 2019 |
| 6. | Ali Raza , Shujat Ali , Maria Akram | Immunity-Based Dynamic Re-configuration of Mobile Robots in Unstructured Environments | Journal of Intelligent & Robotic Systems | 2019 |

MECHATRONICS CLUB

EVENTS



Events & Competition

Being the sole Robotics society of UET Lahore, Mechatronics Club proffers out the organization of technical events to develop the attitude and courage in students for taking up challenges in specialized domains, which eventually shape them and provide them with the essential grooming required besides their curriculum to outshine others in the post-graduation life. Mechatronics Club has its hybrid modules in which non-technical events are also organized. Signifi-

cant events of the Club are Orientation Week.

- ▶ Orientation Week
- ▶ MECHTECH
- ▶ Workshop Week
- ▶ ROBOCOM
- ▶ Industrial Tour

Orientation Week is organized to warmly welcome the junior students of the department & includes multiple interactive activities like Departmental Visit, Photo-Booth, Scavengers Hunt, Orientation Ceremony, and Photo Montage. This week becomes a part of their lifelong memories.

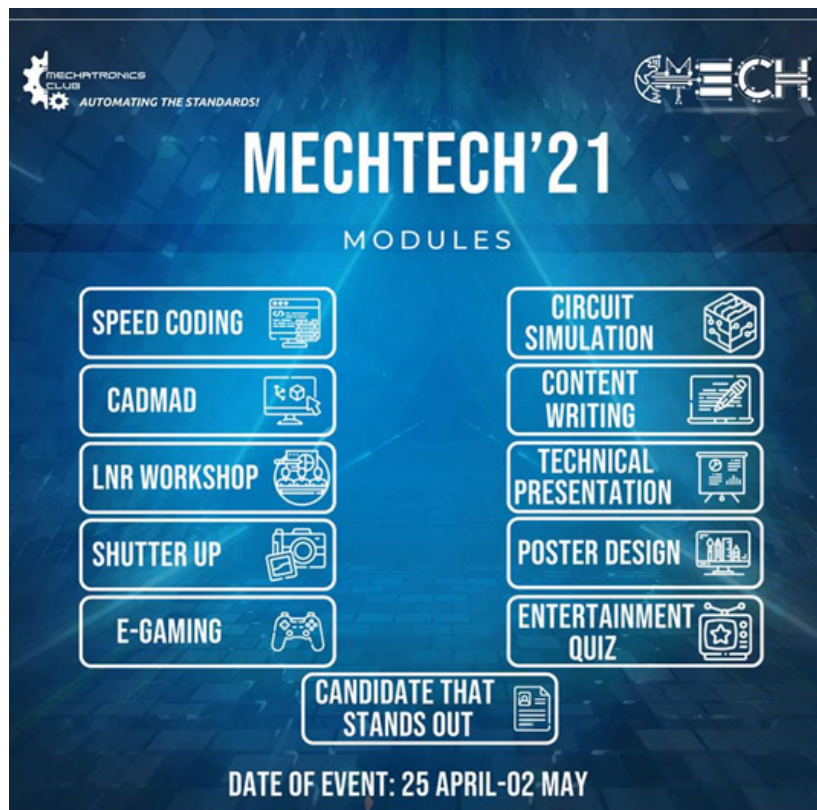


Workshops

Workshop Week brings an opportunity to youth to exercise their skills in diverse domains, i.e., Solid Works, PCB Fabrication, Arduino Programming, Machine Learning, Unity 3-D, Freelancing, etc

MECHTECH

Under the umbrella of MECHTECH, several competitions demanding sharp technical and soft skills are organized. These include Speed Coding, E-Gaming, Intra LFR/LNR, CADMAD, Speed Wiring, Speed Soldering, Technical Presentations, and Logo Quiz. Over the years, these events have provided the students with entertainment, infotainment & technical grind.



ROBOCOM

ROBOCOM is our flagship event. It is an intra-university competition, having participants from all over the country. ROBOCOM includes Line Navigation, Maze Solving, Robo War & RC Car modules. A Robotics Workshop is organized where hands-on experience is provided to the attendees on the industrial-grade robotic arms alongside these modules.



Collaborations

Moreover, numerous other events and workshops are also organized for the grooming, learning, and personality development of the students. Club celebrates Iqbal Day in collaboration with the Iqbal Academy besides its collaborations with AIESEC, IEEE, ASME etc. to organize different extracurricular activities throughout the year.

Industrial Tour

Industrial Tour is organized to provide the departmental students an insight into the Industries working in Pakistan.



QUALISYS WORKSHOP

Qualisys is a prime company in the services domain of precise and sensitive Motion Capture as well as 3D positioning & tracking systems. The company has decades of bright history in which it had provided many high industries with high end camera and optronics systems for motion capturing of several kinds in extreme environments and conditions. Qualisys'

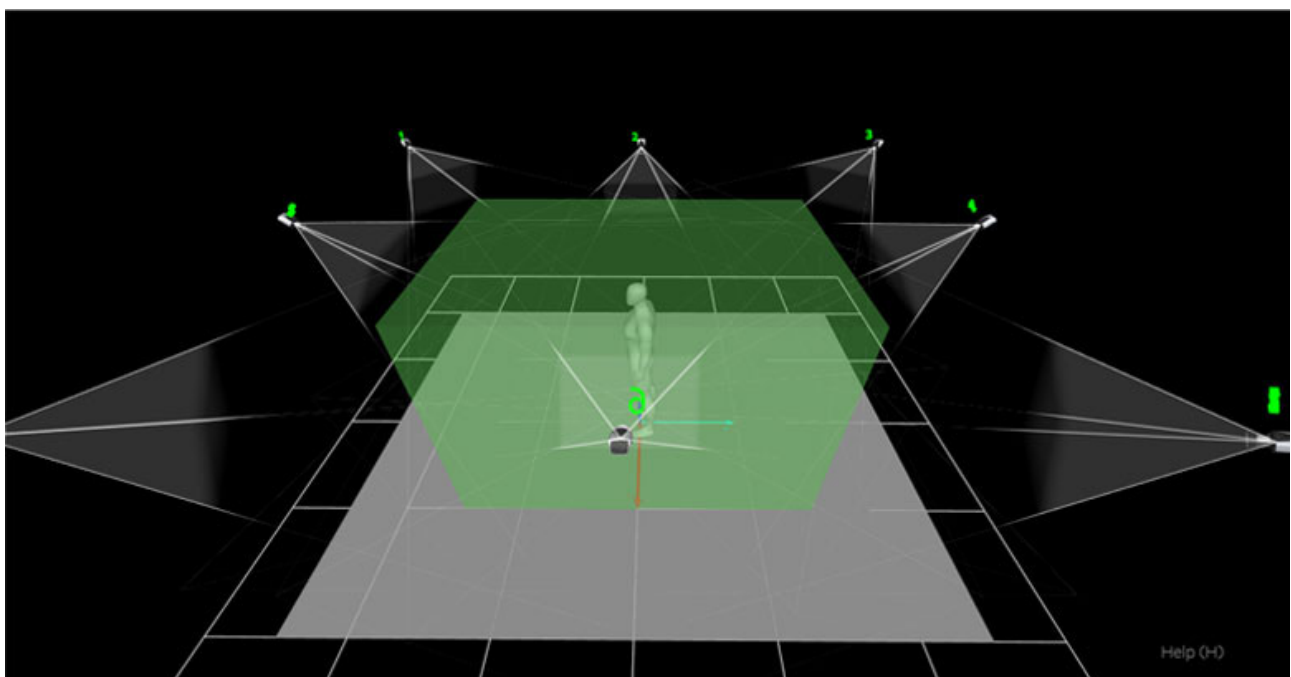
headquarter is located in the central part of the Gothenburg harbor area, Sweden with offices in Europe, North America, and Asia, and with a global distributor and partner network, Qualisys is a very international business providing services over 15 different languages, allowing company to understand the customers' needs and help them get the results they want.

Motion Capturing & 3D Position Tracking

Also known as MOCAP, it is a process of recording movement of objects e.g., human beings, animals, robots etc. to post process the visual data for analysis and further utilization in industry, military, sports, entertainment medical applications and most importantly the medical application. Generally, sensors are placed on the dynamic objects and their movement is recorded, it is then converted into computer 3D or 3D models to analyze and process the captured data. The motion of the dynamic actor or object is captured using multiple cameras

at high rate of frames per second to sensitively map the motion of the object to the computer model.

3D position tracking is quite similar to motion tracking, the position is calculated using a reference co-ordinate system and the sensor data from the object suite is processed to precisely locate the object in a given reference system. The very data can also be used to develop a model to produce dynamic graphics where the model can be mimicked performing desired tasks.



Applications

Motion capture, apart from its use in media and entertainment industry in video games and animations, it can be used in human centered applications. It can be vastly used in the study of biomechanics of human beings to help engineers develop precisely accurate prosthetics. Medical domain can cover the motion study element of human muscles to excel in biological research work. Furthermore, it can be used in: Clinical

Gait Analysis Systems, Gait Research, Functional Assessment of Muscles, Sound & Motion Study, Psychology, MRI Scanning, Underwater Motion Studies, Running Monitoring, Sports e.g., Golf, Cycling, Cricket, Baseball, Swimming, Automotive Sector, OEMs, Robotics & UAVs, UGVs, UWSs and Marine Systems, VR & Animations, Animal Research etc

About the Company

Qualisys hardware is designed to be reliable, easy-to-use and high performing. With the possibility to capture indoors, outdoors, and underwater motions - Qualisys hardware is truly the most versatile optical mocap technology in the market. Their cameras also have the ability to record high-speed, high-resolution calibrated videos that capture both active and passive marker data,

making Qualisys technology suitable for any measurement application. It has Hardware features like Up to 12 Megapixel resolution, Low latency for real-time applications, Active filtering for outdoor captures, Passive & active marker support, Water resistant IP67 housing etc. While for the software part it has Easy trajectory editing, Skeletal data, Rigid body data etc

Workshop At Mechatronics & Control Engineering Department:

Qualisys came to the department of **MECHATRONICS & CONTROL ENGINEERING** at **UET Lahore** to deliver a workshop on their high end technology and modules. In workshop the basic emphasis was on human motion study with help of Qualisys super-spherical markers, Miquis Hybrid and Miquis Video cameras. It was a great experience for the students to learn the

key ideas of the hardware and software synchronization and working in passive and real time environment. The ideas can be utilized in modern robotics to perform precise operations with no latency in real time environment.

FINAL YEAR PROJECTS

Projects are a significant element of any engineering program and degree. Mechatronics & Control Engineers complete various projects to comprehend and implement the knowledge gained by the courses and lab experiments. Depending on the context and scope of the system, semester projects are assigned and evaluated. A significant project termed Final Year Project (FYP) is given to the students in the mid of the sixth semester of their engineering program. The students complete the project's proposed

objectives until the end of the final semester, along with a thesis explaining the project in detail. The faculty of the department supervises different projects depending on their research domains and fields of expertise. The Mechatronics & Control Engineering department offers FYPs in multiple disciplines; machine learning, mobile robots, autonomous robots, control systems, virtual reality (VR), electronics, etc. The following information gives valuable insight into some of the FYPs at our department.

Telerobotic System Using Virtual Reality

This project aims to create a telerobotic system to achieve complex robot manipulation by the simple movement of human arms. It is designed to use a virtual environment that will include a real robotic manipulator having 5-DOF with articulated configuration. In the virtual environment, this manipulator is placed where an operator can quickly move its end-effector. In contrast, the joints in this robot will move accordingly and control the real robot placed remotely. We can use this system in various remote training applications;

Military: Training of pilots, Spying purposes (UAVs)

Medical: Remote Treatment, Surgery

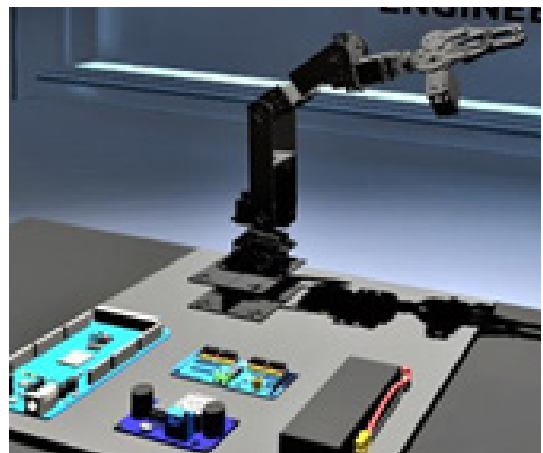
Marine: Exploration, Search, Surveying

Maintenance of underwater facilities

Remotely Operated Vehicles (ROVs)



Operator in real world



Robot in virtual world

Pick and Place Industrial Delta Robot

This project is about the design, development, and control of an industrial-grade delta robot. The primary objective of this project is to make a delta robot performing pick and place operations on objects coming on a conveyor having a weight up to 0.5 Kg. Once the hardware is completed and tuned according to our requirements, a machine vision algorithm will detect the objects along with their orientation and speed through which they are moving; and the end effector will pick and then place them on the desired location. The number of operations per minute depends on the speed of the motor. Our goal is to make a reliable and cost-effective product that can be used by small and local industries according to their requirements and promote automation in small-scale industries. We have some software simulations in MATLAB and Solid Works. The forward and inverse kinematics equations are implemented to validate our project objectives, i.e., workspace of robot and payload capacity.



Human-Machine Activity Monitoring System using Computer Vision

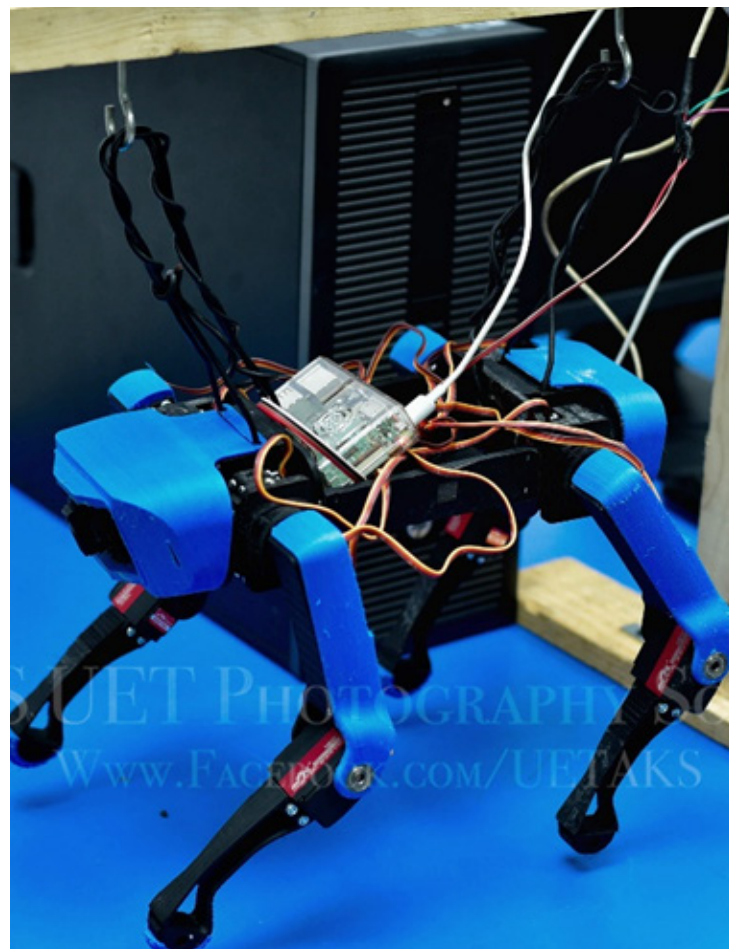
The main idea of this project is to design a vision system using convolutional neural networks for facilitating the supervision of humans and monitoring their activity in a warehouse. Such a system solves a significant issue faced by the industries and optimizes the resources required for surveillance. In every organization, there is a surveillance room where security personnel supervises the activities inside the warehouse. For large warehouses, a whole team performs the job. Scientific evidence suggests that humans' attention span is limited, which further deteriorates with hefty repetitive tasks. Surveillance for an 8 hours shift becomes hefty and inefficient.

The prime focus of the system is to facilitate the existing industrial environment. It uses footage from pre-installed surveillance cameras to detect the efficiency of workers and machines throughout the day. An efficiency report is generated to contain time logs, prohibited area violations, efficiency measures, and intelligent suggestions for better resource utilization. The system has vast applications in warehouse surveillance and construction site supervision. We can further improve the design for the generalized use of overall industrial and non-industrial laborers and machinery. It can be further modified to keep the separate performance track of each person working in the camera's field of view.



Four Legged Companion Robot

This project aims to design a 4-legged companion robot mainly focusing on the legs'-hardware and body design that helps the robot stabilize both in static and dynamic situations. Its degrees of freedom will play an essential role according to the required tasks of walking and running. The 4-legged robot aims to play a role in different areas as the workforce. We can use the robot for various applications and situations. The companion robot can work as a companion to a person, such as in hospitals and small offices, to help run day-to-day errands efficiently and give dog therapy for stress relief.



ALUMNI ACHIEVEMENTS

Dr. Atif Mahboob - Batch of 2011

Dr. Atif Mahboob is one of the most honored and celebrated students of the Department of Mechatronics & Control Engineering. Through his consistent efforts and hard work, he has earned recognition internationally through his work on SysML, a virtual reality-based product experience research domain. He was awarded the Scientific Award 2021 in his doctoral thesis at the ProSTEP iViP Association.



Engr. Daud Warraich - Batch of 2005

Engr. Daud Warraich is another esteemed alumnus of the department of Mechatronics & Control Engineering. After graduating from Mechatronics & Control Engineering department UET, Lahore, he won a research scholarship at the University of New South Wales. Later, he served in CSL as JAG PMCS Manager (Automation Systems) and a research officer at RMIT University. Currently, he is working as a Manager Manufacturing Controls in Tesla, Inc and has close working ties with Elon Musk. In a recent conversation, he advised us regarding the prospects of professional life as follows, 'While the contrast is there, the fundamentals were the same; learn new things, know your roots, respect everyone and never say "No" to a job. In 20 years, I have learned that I don't know everything, and that's ok.'



Engr. Sameen Ghaffar - Batch of 2014

Engr. Sameen Ghaffar is another honored alumnus Mechatronics & Control Engineer from our department. She is currently working at Alstom Transport in Amsterdam, Netherland. She serves as a Test Engineer at the company and handles the testing and commissioning processes of the Metro train.



OPPORTUNITIES

With the broad category of skills, Mechatronics & Control Engineers are equipped to work almost anywhere. Many enterprises are moving towards humanoid robots and other forms of automation. In the aircraft manufacturing industry, robots are now being used for drilling, welding, and even inspection. In the medical domain, automated, sensor-equipped systems can

help monitor vital signs, while medical robots can support patients enduring rehabilitation and even assist surgical tasks. In manufacturing meanwhile, innovative assembly lines improve efficiency while holding down costs. The new era of automation and industry 4.0 shows that the jobs and skills of mechatronics will be massively demanded in the upcoming years.



Job opportunities for Mechatronics & Control Engineers in Pakistan

The scope of Mechatronics & Control Engineers is mainly in robotics engineering, telecommunication engineering, HMI systems, automation system and industrial control systems. Many hi-tech engineering industries in Pakistan hire Mechatronics & Control Engineers; major ones that are enlisted below-

- ▶ HONDA Atlas Cars
 - ▶ Nestle
 - ▶ PepsiCo
 - ▶ Coca Cola
 - ▶ Fatima Group
 - ▶ Engro Corp.
 - ▶ Packages Ltd.
 - ▶ Tetra Pak
 - ▶ DESCON
 - ▶ Avanceon
- Mechatronics & Control Engineers can apply for the various positions depending on their experience and skills. Some of these are entitled as-
- ▶ Management Trainee Officer (MTO)
 - ▶ Graduate Trainee Engineer (GTE)
 - ▶ Automation Engineer
 - ▶ Production and Quality assurance Engineer
 - ▶ Instrumentation and Control Engineer

Academic and Research Opportunities

Mechatronics & Control Engineers can also pursue their careers as full time Research and Development (R&D) engineers in different companies. This is a specialized job and requires atleast a Master's degree but preferably a PhD degree.

Mechatronics & Control Engineers can pursue different research domains depending on their research orientations and field on interest. Broadly categorizing, Mechatronics & Control Engineers may pursue the following potential research fields:-

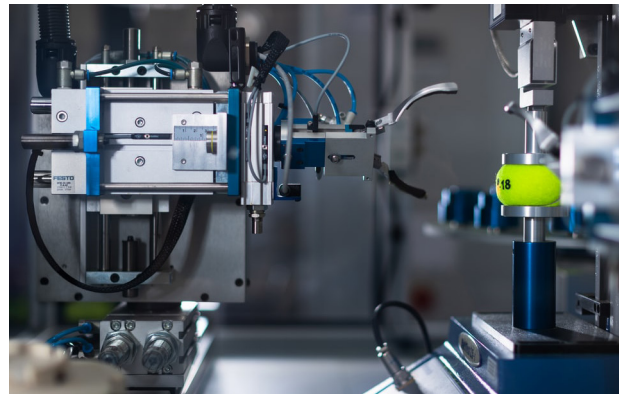
- ▶ Robotics
- ▶ Automation
- ▶ Control Systems
- ▶ Artificial Intelligence
- ▶ Data Science
- ▶ Renewable Energy
- ▶ Digital Electronics
- ▶ Embedded Systems and Technology
- ▶ Software development

Normally, due to lack of R&D sector industries in Pakistan, most of the engineers serve abroad in different organizations and institutes. After completing their PhD's, they tend to serve in the industries as well as large organizations. Some of the top organizations and institutes where Mechatronics & Control Engineers serve are enlisted below:-

- ▶ Massachusetts Institute of Technology (MIT)
- ▶ CALTECH
- ▶ Stanford University
- ▶ Cornell
- ▶ Schlumberger
- ▶ KUKA
- ▶ ABB

- ▶ Rockwell automation
- ▶ Apple

Depending on the aptitude and skills of Mechatronics & Control Engineers, they are currently serving and leading all major industrial and academic sectors. With the current pace of technological development, the need of Mechatronics & Control Engineers and other integrated technology engineers will grow rapidly.





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