Innovative Research Contribute to Prosperity

Research and innovation contribute to boost growth and employment. At the same time, it helps make people's lives better by improving healthcare, transport, digital services and countless new products and services. Pakistan's future is connected to its power to innovate: to turn great ideas into products and services that will bring growth to our economy and create jobs. The Office of Research, Innovation and Commercialization (ORIC) has been established in Mirpur University of Science and Technology (MUST) with the responsibility to build research capacity in the university and commercialize university research products through building links with local industry. A more innovative and knowledge-driven economy can be reinforced by closer linkages between research institutes, universities, and the industry. When companies and universities work in tandem to push the frontiers of knowledge, they become a powerful engine for innovation and economic growth. Higher Education Commission (HEC) in its MTDF HE-II has recognized the need for enhanced university-industry-government linkages and has already taken steps for university-industry technology support programs, career centers, collaborative programs, and research centers in priority areas for the socio-economic development of the country.

MUST has allocated sufficient funds for small innovative research projects; proposed by the researchers of the university. The goal of this program is to provide start-up capital for good innovative ideas in the field of science and technology. We have selected few success stories of the innovative research projects; furnished by ORIC through the MUST's "Small Research Grant Program".

The First Autonomous Vehicle of Pakistan

The research on the "First Autonomous Vehicle of Pakistan" was carried out, with the financial assistance of Office of Research, Innovation and Commercialization (ORIC), in the Intelligent Transport Lab, Department of CS & IT, Mirpur University of Science & Technology (MUST, Pakistan by Mr. Faisal Riaz (Assist. Prof) in 2015. His research team encompassed: Mr. Talha Ahmed Lodhi (BSCS), Muhammad Atif Butt (BSCS), Muhammad Farrukh Farid (BSCS), Hassan Ali Asghar (BSCS), and Bilal Ahmed Tariq (BSCS).

EMO is the acronym used for dual seat Emotions Enabled Autonomous Vehicle. The basic purpose of this research was to design a human inspired truly autonomous vehicle, which makes decisions while using both cognitive and emotional cues. The first version of this autonomous vehicle was inaugurated by worthy Prof. Dr. Samar Mubarakmand, a Famous Atomic Scientist, in December, 2016. This version of EMO received much appreciation by the researchers of almost all universities of Pakistan. This prototype offers the features like; Passenger Communication System, 360-degree Field View using long and short range sonars (5 feet range),

Emotions Inspired Collision Detection and Avoidance, Vehicle-2-Infrastructure Communication, Vehicle-2-Vehicle Communication System, and Auto accident reporting.

The second version of EMO has been recently launched on December 18, 2017 in "DICE-2017 Mega Innovation and Entrepreneurship Event" where it won 1st prize while competing with engineering projects of all participating universities of Pakistan. This version of EMO was modified by incorporating features as; Auto Pilot, 360 degree FOV using 3D Lidar (40 meters range), Computer Vision based Environment Classification, Machine Learning, Human Inspired Driving Strategies and Enhanced Passenger Communication System.

Basically, EMO has been designed as a cheap autonomous vehicle for a small family while keeping in mind the purchasing power of the common people as well as comparing it with the Tessla and Google Car. The car is designed in such a way that it can be extended for the medium sized family as well. The electric electric batteries will help achieve zero emission and lead to the solution of the pollution problems. The number of collisions will ultimately be decreased by the state-of-the-art collision detection and avoidance technology. The plug and play technology of the EMO can be installed on any platform, which make it suitable to be used as industrial autonomous loaders to carry the raw material from place to place within the vicinity of any industry. The research team is very confident that their product will receive a positive and encouraging response from the industrial sector.

Hybrid Motor Cycle

This project is led by Dr. Khuram Pervez and followed by one of his MS students, i.e. Mr. Ahsan Arshad, who has been a key member and had been working consistently on this project. Dr. Khuram is serving as Assistant Professor in the Department of Mechanical Engineering of Mirpur University of Science and Technology, AJK, Pakistan with over 17 years' of professional experience in the fields of Energy and Mechanical Engineering. Dr. Khuram is also a Chartered Engineer with UK Engineering Council, Registered Engineer with Pakistan Engineering Council and is a full member of Energy Institute of United Kingdom.

The main objective behind this project was centering on embedding energy efficiency. This hybrid motor cycle can be run on petrol as well as on a battery. Its cost effectiveness, less dependency on fuel and environment friendly features make it a perfect choice for ordinary people of the country. The 1200W hub motor placed in the front wheel takes power from a lithium Ion battery via a controller. On a straight road, 50 km distance could be travelled using this battery with a maximum speed of 45km/hr.

Recently this project, Hybrid Motor Cycle, has gained enormous recognition by researchers as well as by the industrialists during "DICE-2017 Mega Innovation and Entrepreneurship Event" organized by MUST with the collaboration of DICE Foundation, USA. The project was also appreciated by renowned scientist Dr. Samar Mubarakmand during an event organized by Green Society MUST in 2017. The project won 2nd prize in that event.

The research team is working on improving the design and efficiency of this motorbike based on feedback received from the industrial sector. It is also inspiring that the research team is also working to improve the efficiency of its kit which would be easily installed in any other motorbike by minor modifications. Hopefully, this kit will receive very encouraging response from the local motorbike market.

Eco-Friendly, Sustainable, Self-Compacting Concrete Incorporating Ceramic Waste

The research on "Development of Eco-Friendly, Sustainable, Self-Compacting Concrete Incorporating Ceramic Waste" was carried out with the financial assistance of Office of Research, Innovation and Commercialization (ORIC), Mirpur University of Science & Technology (MUST), Pakistan by Mr. Muhammad Tausif Arshad, Assistant Professor, Department of Civil Engineering, MUST. His research team comprised of Mr. Syed Afraz Shah and Mr. Zishan Tariq postgraduate students of MUST.

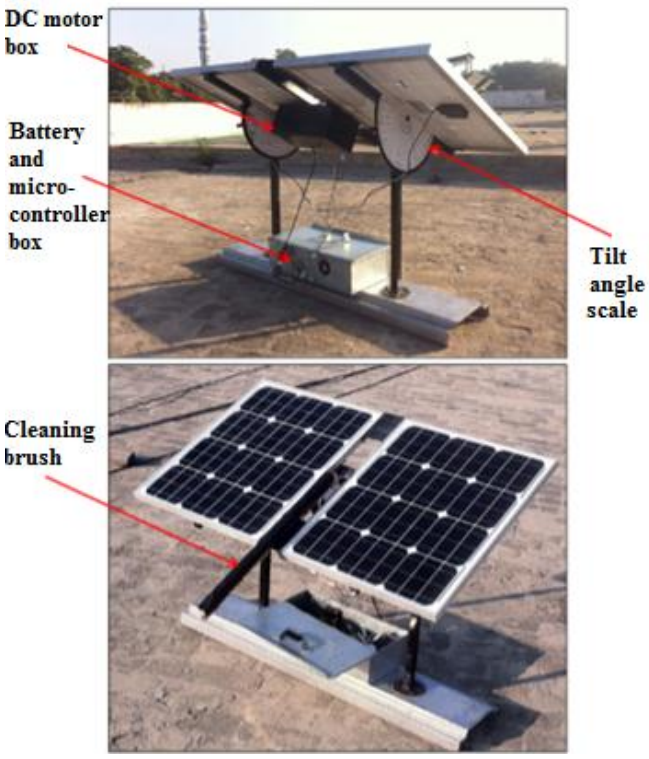
Construction and demolition (C&D) wastes contribute the highest percentage of waste worldwide. Furthermore, ceramic materials, which include brick walls, ceramic tiles and all other ceramic products, contribute the highest percentage of wastes within the C&D wastes. The current option of disposal for this type of waste is landfill. Unavailability of standards, avoidance of risk, lack of knowledge and experience led to there being no active usage of ceramic waste in construction. In Gujrat district more than 100 pottery units are working. Almost 14 tons waste is produced by each unit. Disposal of this waste is a problem. During this project Ceramic wastes were used as partial replacement of natural aggregates in production of self- compacting concrete. Concrete is evaluated by using different destructive and nondestructive techniques. Natural aggregates were replaced up to 50% with ceramic aggregates. Results are encouraging as compressive strength of modified concrete was more as compare to ordinary concrete. Furthermore, ceramic waste aggregates increase the compact ability as unit weight of modified concrete was more as compare to ordinary concrete.

The key findings of this research included: Huge wastage of the ceramic industry will become hospitable, cost of the construction will be lowered by reduction in size of reinforced concrete members, cost of SCC will be reduced by replacing natural aggregates with crushed ceramic aggregate, protection of natural resources, protection of human health and environment by reducing adverse per capita environment impact, promotion of cottage industry, adequate, safe and affordable housing for everyone.

This finding can be adopted by precast industry and NHA or PHA for construction of rigid pavements. It also gives a viable solution for disposal of ceramic waste. The project was displayed in "DICE-2017 Mega Innovation and Entrepreneurship Event" which was organized by MUST will the collaboration of DICE-Foundation, USA. It was pitched in front of industrialists during DICE Shock Session and funded by on of the industrialist

participated from Islamabad. In future, work can be extended to partial replacement of sand and cement with ceramic waste.

Self-Cleaning Device for Pole Mounted Solar Photo Voltaic (PV) Installations



The research project led by Dr. Khuram Pervez, Assistant Professor in the Department of Mechanical Engineering MUST, was funded by ORIC-MUST. The project aimed to design and develop a self-cleaning device for such PV installations where human access and manual cleaning is difficult. Dust can significantly affect the performance of pole mounted PV installations. Design and fabrication of device allows the SCM to start cleaning cycle after every 24 hours for a period of 20 seconds. It also restricts the SCM to continue the cleaning process during rain or when the battery voltage level is low. The experiments were done at two identical pairs of PV panels tilted at 33° angle, one with SCM and one without, for a period of six weeks in the climatic conditions of Pakistan. Irradiance, dust density and other performance parameters such as maximum power output, short circuit current, open circuit voltage, fill factor and panel efficiency were recorded. The results revealed that with the increasing dust density, the output power, short circuit current and efficiency decreased dramatically for the PV pair without SCM, i.e. by 85%, 80% and 86% respectively. On the other hand, the PV pair having SCM showed fairly a consistent performance due to regular cleaning of the panel surfaces. The proposed SCM is a cost effective mean of removing accumulated dust with a payback period of 2.04 years.

This research has been published in the form of a research paper in a Science Citation Index Expanded Journal **"Thermal Science"** which has an Impact Factor of 1.2.