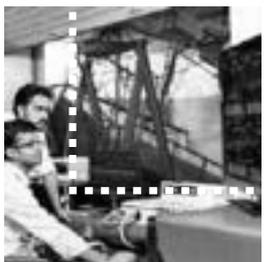


Compassion Driven

RESEARCH

at AMRITA





OUR RESEARCH PHILOSOPHY

Inspired by our Chancellor, compassion-driven research with a strong societal impact is the dominant theme underlying the University's vision and priorities. This theme runs through our thrust areas of research in Science, Technology, Medicine, Humanities and Social Sciences, and aligns with several of the United Nations Sustainable Development Goals (UN-SDGs).

In addition to having a strong societal benefit through real-world deployments that are saving lives and improving the quality of living, research at Amrita has also resulted in high-impact publications and patents.

Amrita is ranked #1 in Research Funding by the Ministry of Human Resource Development (MHRD), Government of India. The University has over 800 research scholars, more than **30 research centers** - 20 of which have been identified as **Centers of Excellence**.

Chancellor's Message

"Today, universities and their researchers are ranked mainly based on the amount of funding they receive, the number of papers they publish, and their intellectual caliber, but along with this, we should take into consideration how much we have been able to use their research to serve the lowest and most vulnerable strata of society. If we could transform compassion from a mere word into a path of action, we would be able to solve 90 percent of the world's humanitarian problems."



SRI MATA AMRITANANDAMAYI DEVI
Chancellor, Amrita Vishwa Vidyapeetham

254
INTERNATIONAL PROJECTS

137
PATENTS (granted and pending)

30
RESEARCH CENTERS

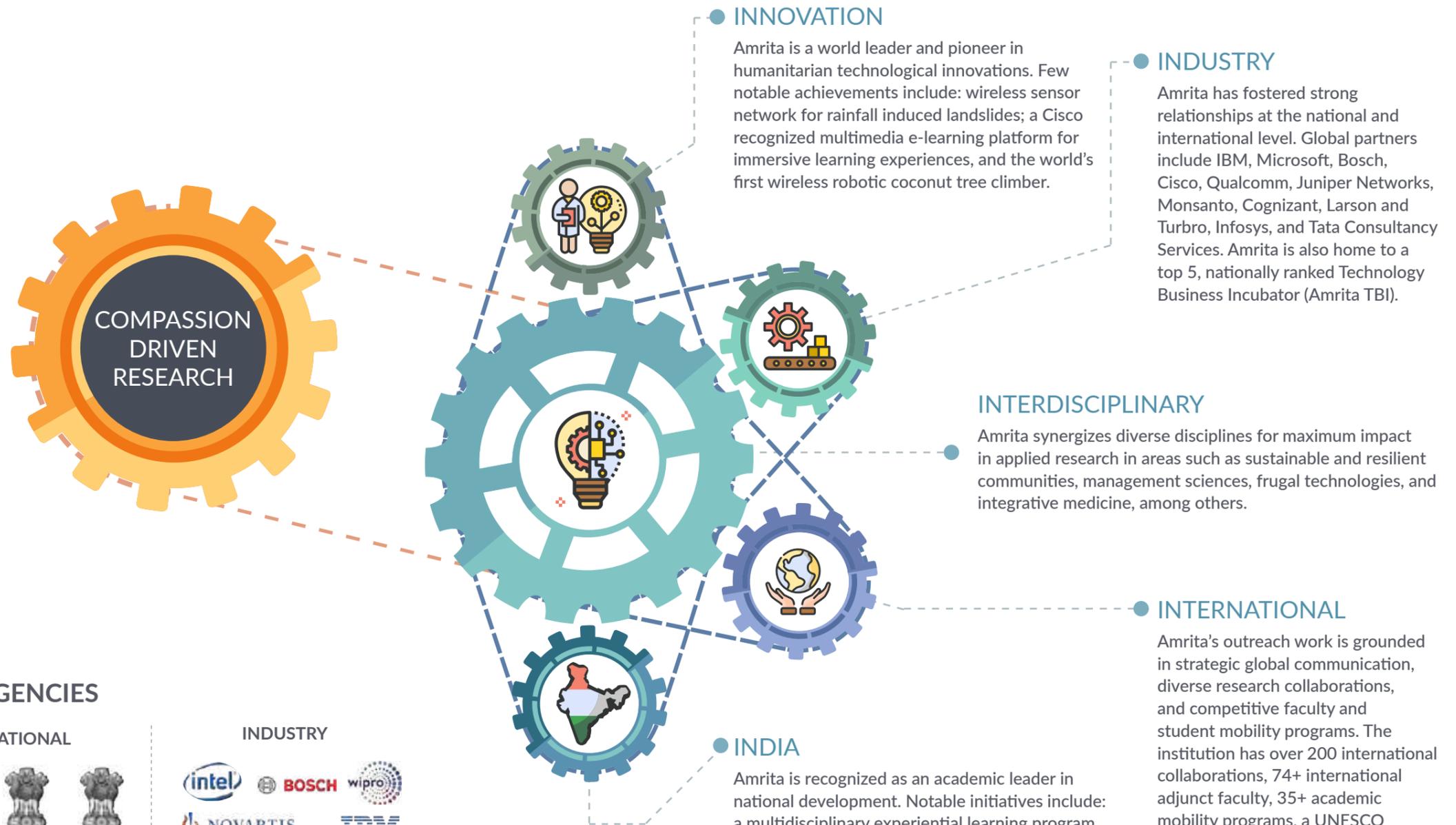
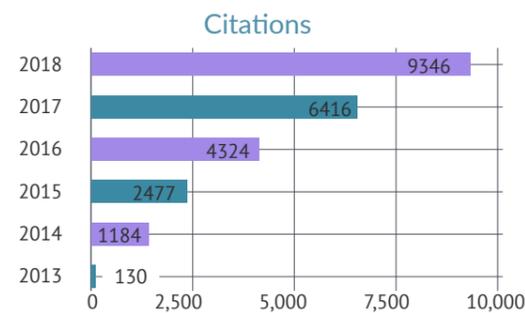
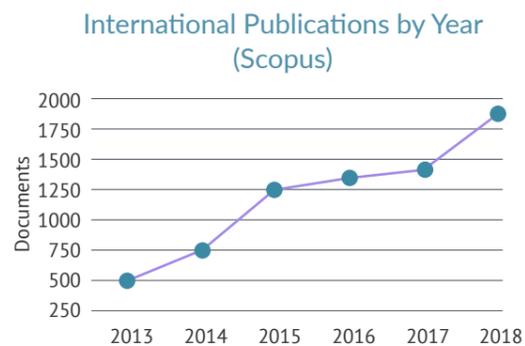
\$72 MILLION
RESEARCH FUNDING

12,000+
INTERNATIONAL PUBLICATIONS

20+
CENTERS OF EXCELLENCE

FIVE PILLARS (I5s) OF AMRITA

The core vision of Amrita lies in providing education for life, grounded in intellectual social responsibility through compassion driven research that will translate into a positive global impact. This vision is supported by five pillars (I5s): Interdisciplinary Education & Research, Cutting Edge Innovation, International Outreach, Industry Partnerships, and Social Transformation in India.



● INNOVATION

Amrita is a world leader and pioneer in humanitarian technological innovations. Few notable achievements include: wireless sensor network for rainfall induced landslides; a Cisco recognized multimedia e-learning platform for immersive learning experiences, and the world's first wireless robotic coconut tree climber.

● INDUSTRY

Amrita has fostered strong relationships at the national and international level. Global partners include IBM, Microsoft, Bosch, Cisco, Qualcomm, Juniper Networks, Monsanto, Cognizant, Larson and Turbo, Infosys, and Tata Consultancy Services. Amrita is also home to a top 5, nationally ranked Technology Business Incubator (Amrita TBI).

● INTERDISCIPLINARY

Amrita synergizes diverse disciplines for maximum impact in applied research in areas such as sustainable and resilient communities, management sciences, frugal technologies, and integrative medicine, among others.

● INTERNATIONAL

Amrita's outreach work is grounded in strategic global communication, diverse research collaborations, and competitive faculty and student mobility programs. The institution has over 200 international collaborations, 74+ international adjunct faculty, 35+ academic mobility programs, a UNESCO chair in Gender Equality & Women Empowerment, and a World Center of Excellence on Landslide Disaster Reduction.

● INDIA

Amrita is recognized as an academic leader in national development. Notable initiatives include: a multidisciplinary experiential learning program in rural India; a ₹100 crore initiative to bring clean drinking water to Indian villages; a Gates foundation grant to reinvent rural toilets; a UN funded initiative for rural women empowerment and vocational training; and a nationally adopted sustainable waste management initiative.

FUNDING AGENCIES

INTERNATIONAL



NATIONAL



INDUSTRY



PIONEERING INNOVATIONS: FIRST IN THE WORLD

Amrita has broken barriers and attained global recognition for its work. With a focus on innovative thinking, integrated research, and understanding and meeting the needs of the future, researchers strive to develop solutions with real-world applications for the betterment of society.

Wireless Sensor Network for Landslide Detection

This unique research has developed a resilient low-cost system by integrating knowledge from multiple domains - earth science, communication & networking, analog & digital circuits, etc. The complete system in Munnar, Kerala has been designed to detect landslides 24 hours ahead of time. The system has received a U.S patent and is now being considered for deployment in other landslide prone areas throughout India. The University is officially recognized as a World Center of Excellence for Disaster Risk Reduction by the International Program on Landslides.

Amrita Oceannet - Internet Connectivity to Fishermen at Sea

OceanNet offers low-cost internet connectivity for fishermen at sea to help stay safe, providing network-connectivity up to 60 km. Each boat's coordinates, speed, and course is tracked on a land-based server with support included for SOS calls.

Nano Polymer Wafer for Brain Cancer Treatment

This flexible, multiple drug-embedded polymer sheet can release chemo-prophylactic drugs gradually over several months. Acute recurrent brain-tumors have been treated by placement of the wafer-thin polymer sheets in resected tumors. This product is far superior to the current existing product called Gliadel wafers.

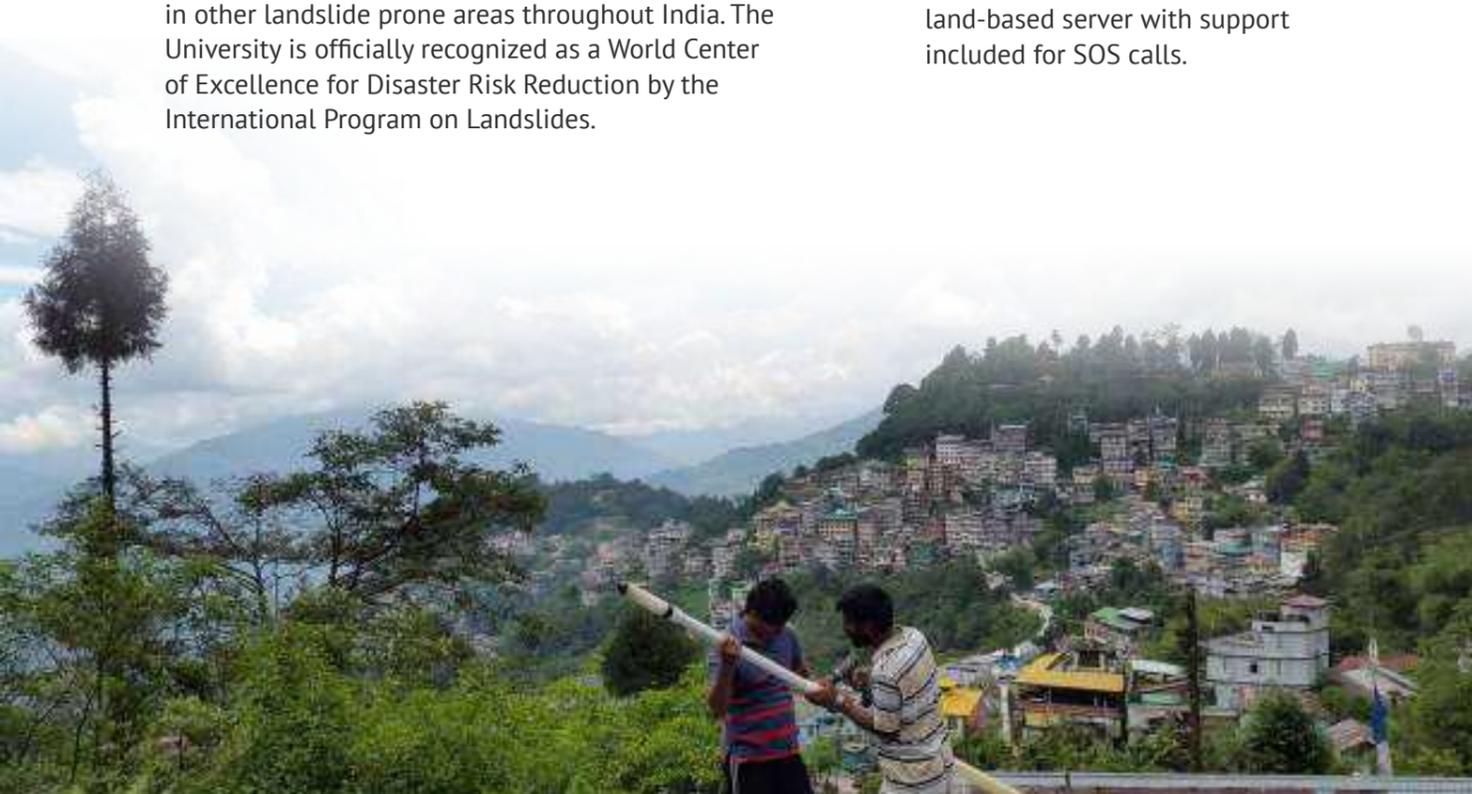
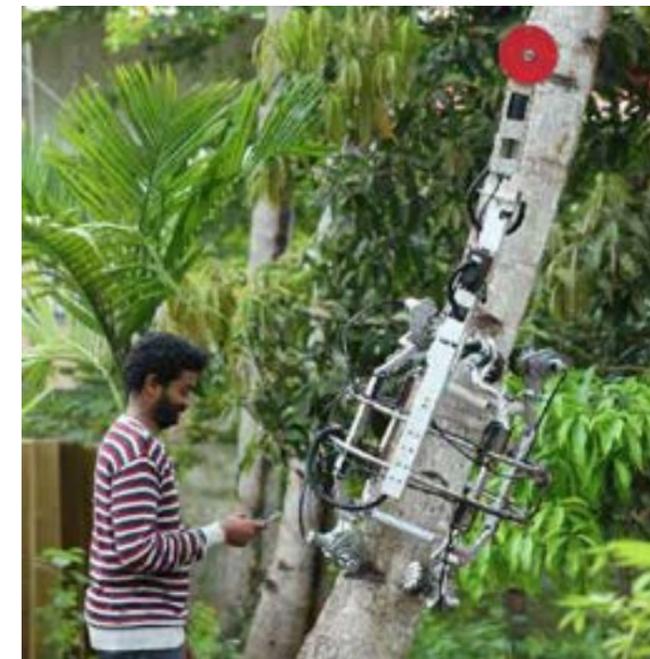


Haptic Devices for Skill Development

Haptic technology as a modality takes advantage of the sense of human touch by applying forces and vibrations to provide life-like experiences to the user. Pioneering contributions in the area of haptic systems for skill assessment and guidance for applications such as vocational education and training, physical rehabilitation, and medical simulation. Specific research areas include haptic rendering, haptic devices, haptic guidance, and shared control schemes for haptic simulation.

Amaran: Semi Autonomous Coconut Harvesting Robot

As there is a severe shortage in human coconut tree climbers, there is a dire need to help the coconut tree farmers and the consumers who are suffering a lot due to inability to harvest coconuts in time, which has led to severe increase in price of coconuts. Given this real-world challenge, students and faculty designed and developed Amaran - a coconut tree climbing robot to help farmers pluck coconuts. The innovation has been filed for a patent and received the Best Mechanical Design Award.



INNOVATIONS FIRST IN INDIA

Amrita engages in research and design with emphasis on contributing to the social stability of the nation by empowering India's masses in a sustainable, cost-effective, and scalable way through innovative technological solutions and resources.

Light-Weight Bullet-Proof Materials for Indian Army

Amrita received the Indian Army's very first Technology Development Fund (TDF) project for the development of light-weight bullet-proof materials for Indian soldiers stationed on the frontlines.

Deep Brain Stimulation (DBS)

A DBS implant surgery using medical robot technology was performed at the Amrita Institute of Medical Sciences, allowing a young patient of Parkinson's Disease to lead a near-normal life. The surgery was conducted at the hospital free of charge due to the financial situation of the patient.

India's First Double Organ Transplant

Simultaneous Pancreas Kidney (SPK) transplantation was performed on a 35-year-old man. The main advantage of this combined transplantation is improvement in quality of life and freedom from diabetes-related complications and dialysis. It also avoids frequent blood sugar testing and occurrence of life threatening hypoglycemia.



Double Hand Transplant

Amrita conducted India's first double forearm transplant. This is the third double-hand transplant at the hospital, which is currently the only facility in India with the capability to conduct hand transplants. This surgery was technically more complicated than the previous two hand transplants done at AIMS. Identification, tagging and connecting the nerves, tendons and arteries is very challenging, thus forearm transplants have been attempted only a few times in the world.



A-VIEW: Amrita's Flagship E-Learning Platform

Amrita Virtual Interactive E-Learning World (A-VIEW) is an award winning indigenously built multi-modal, multimedia e-learning platform that provides an immersive e-learning experience that is almost as good as a real classroom experience. Honorable Prime Minister, Shri Narendra Modi, used A-VIEW to interact with Skill Training centres across the country on Youth Skills Day.

Male to Female Upper Arm Transplant

A 19 year-old girl received an upper double-arm transplant from a male donor at Amrita Hospital. The procedure was India's and Asia's first upper arm double-hand transplant and only the 9th ever to be performed successfully in the world. This was also the first time in the world that a male donor's hands were transplanted onto a female recipient.

Open Fetal Surgery

Doctors at Amrita Hospital achieved a significant breakthrough by successfully operating on a baby with a birth defect by taking it out of the mother's womb, performing corrective surgery, placing it back inside the womb, with the baby subsequently being carried to term. The 21-week foetus had a giant tumour in the right lung that was pressing on its heart. The procedure is a major milestone in the treatment of congenital problems before birth.



Amrita Health Care Information System (HIS)

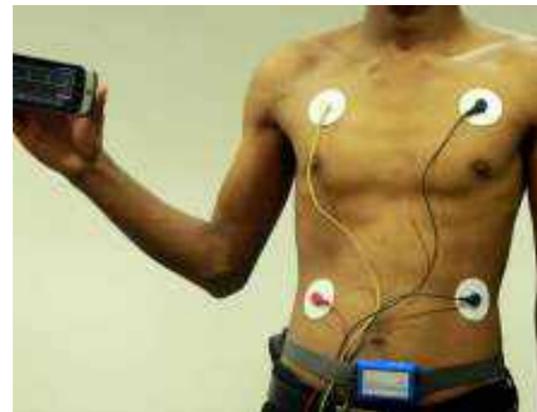
Amrita Healthcare Informatics Suite is a demonstration of Amrita's leadership in research and development of state-of-the-art technologies. Amrita HIS is a comprehensive software solution that allows a holistic approach within and across clinical segments,

delivering solutions with the innovation and synergy necessary to help move forward in today's changing healthcare environment. The system not only helps in daily patient care management, but it also provides the foundation to foster research and development.



Automated Insulin Pump

Amrita developed a low-cost, automated insulin pump designed for personalized and continuous delivery of insulin in a subcutaneous matter with all functionalities. The innovation was awarded a U.S. patent and the Alexander Graham Bell Award in the category of mHealth.



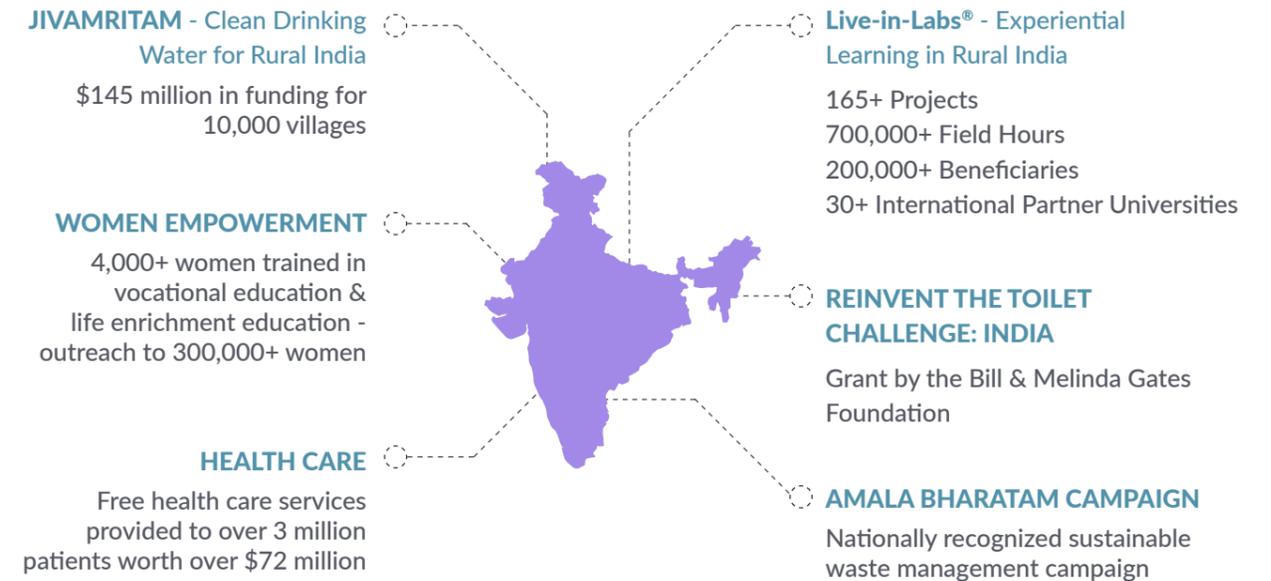
IoT for Remote Health Monitoring

Amrita Spandanam is a low-cost, low-power, wearable, wireless ECG monitoring device for real-time monitoring of cardiac patients to help avoid exorbitant medical costs of hospitalization.



OTHER NOTABLE PROJECTS

Several additional research projects have been initiated for the welfare of society, both domestically and around the world



Karshaka Amrita Dhara IoT based Irrigation Control System

Amrita researchers developed a system that dramatically reduces water use in agricultural irrigation. In a pilot project on a 4 acre mulberry farm in Periya Puthoor village, Tamil Nadu, the IoT-based system was able to reduce the number of hours of irrigation from an average of 5 hours a day to one hour a day, thus dramatically reducing both water and electricity consumption.

Computer-Based Medical Simulation

The MEDSIM project allows health sciences students to visualize, learn, practise and experience a variety of medical skills and procedures in order to provide a simulated patient experience. MedSim is an e-learning platform that supports computer based medical simulations that replicate clinical scenarios by integrating 2D and 3D animations.

Raman Cancer Diagnostic Tool

A realistic high performance noninvasive light-based diagnostic tool using Surface-enhanced Raman spectroscopy (SERS) will make it possible for large scale screening of oral cancers, one of the most common cancers in India. This will enable early diagnosis and treatment that is vital for curing several forms of the disease.

Integrated Nanomaterial-Based Photovoltaic Storage Devices

The project combines solar cells with supercapacitors and batteries and integrates them with nanostructured thin film electrical storage materials with high surface area and storage capacity. A range of nanomaterials are investigated such as nanocarbons, metal oxides and a variety of processing techniques and deposition methods.



Cloud-Enabled Smart Solution for Diabetes Care

The project utilizes the patented Automated Insulin Pump as well as the novel non-enzymatic glucose monitoring system developed by Amrita and linked via a mobile application developed by Wipro Technologies. Data from patients utilizing these devices are transferred via the mobile app to a cloud, thus providing an interface between a diabetic patient and a 24x7 diabetes helpline. The project holds tremendous potential for the 65 million diabetic patients in India today.

Women Empowerment Through Innovative Vocational Education & Training

In partnership with the United Nations Democracy Fund, the Women Empowerment (WE) Project offered Computerized Vocational Education Training (cVET) and Life Enrichment Education (LEE) to women with low levels of literacy living in remote, impoverished communities over an 18 month period. The project reached over 3,000 women in the Indian states of Kerala and Tamil Nadu and over 900 in other states, totaling 4,000 women.

MUDRA: Gesture-Driven Wheelchairs for Handicapped Patients

Various research studies conducted all around the world reveal that 75% of people with debilitating physical disabilities experience significant difficulties for their day-to-day movements. The system named 'Gest-BOT' uses a small camera mounted very close to the user's hand, tracking the small movements of their fingers to understand the direction of movement of the wheelchair. A gesture recognition system which identifies the gesture is then interfaced to the wheelchair control system to move it to the desired location.



Rural India Tablet Enhanced Education (AmritaRITE)

Using low-power android tablets, Amrita RITE surmounts inherent power and connectivity issues in remote rural areas and brings educational content that is multilingual and culturally appropriate to a person's fingertips. Accurate character recognition software for multiple Indian languages aids in offering quality education to rural communities in Indian and breaks barriers to learning.



Saukhyam: Reusable Sanitary Napkins

Made of banana fiber, Saukhyam pads last for 4-5 years and are available for less than ₹ 500. Those switching to reusable pads now no longer need to spend ₹ 100 (or more) on monthly disposable pad purchases. Most disposable pads are not biodegradable and will pollute the planet for hundreds of years after being thrown away. In December 2016, the pads won the Most Innovative Product Award from the National Institute of Rural Development in India and was lauded at the UN Climate Change Conference in 2018 in Poland for its sustainable financing mechanism.

Amrita Unmanned Aerial Systems

Addressing the pressing need for a medical payload dropping solution deployable during disasters like the Kerala floods and the Uttarakhand flash floods that paralysed India, Amrita researchers have embarked on a targeted delivery system carried on a multirotor vertical take off and landing UAV. This project seeks to draw from the disaster response expertise of the State Disaster Management Authority coupled with aerial robotics engineers at Amrita to deliver a scalable, effective and indigenous solution. So far, the research team has tested over 21 UAV variants, carrying diverse payload sizes and configurations for endurance of flight.

IoT Based Crop Protection System

The team designed a solar-powered intelligent system that can be used to prevent crop damage due to wild animals. The system implements IoT technology along with simple sensors and makes use of four junction boxes that are central to the system architecture. This IEEE SIGHT funded project can improve the yield of crops and, in turn, help farmers to increase their income.



Robotic Arms for Limb Amputees

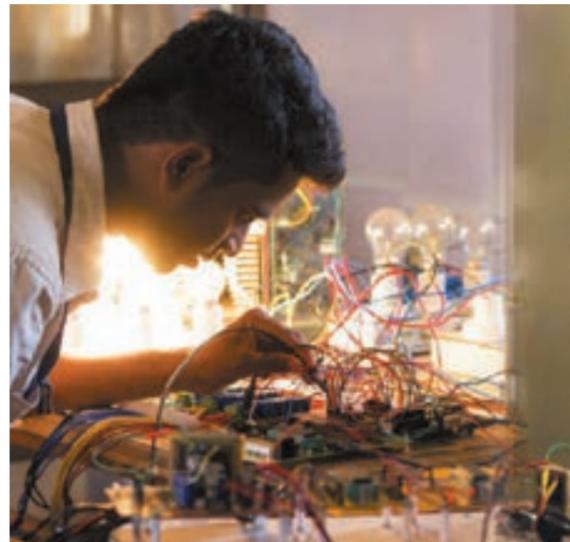
In India, approximately 21 million people are physically disabled which mostly include limb amputees and paralysis patients, with at least 20 percent of people living below the poverty line have some kind of disability. Therefore, there is a need for a device which is of low cost and can be accessed by all classes of people to help them lead a self-dependent life. Researchers at Amrita developed a robotic prosthetic arm, with myoelectric sensors, that can be used for amputees.

Solar-Powered E-Cycle

An energy capturing bicycle capable of generating free and clean energy was designed, developed, and deployed by an Amrita research team. The patented E-cycle has a hybrid system which integrates both cycle dynamo and a renewable energy source garnering sufficient energy for lighting a rural home.

Amrita Wireless Smart Grid

Amrita initiated the Wireless Smart Grid project envisioning a country with a reliable and efficient energy system with electricity access for everyone consisting of electrical providers, systems of power delivery, and smart buildings. To solve the present power crisis, using renewable energies such as solar and biogas, each building is integrated with a main grid and a renewable energy generator. Multiple projects in sustainable smart-grid solutions integrated with renewable energy technologies for rural electrification have been successfully implemented for seamless generation, transmission, and distribution in several villages since 2014.



Jivamritam: Community-Based Solution for Clean Drinking Water

Launched by the President of India, Sri Ram Nath Kovind, on October 8th 2017, the Jivamritam Community-Based Clean Drinking Water initiative aims to install drinking water filtration systems in 5,000 villages and provide clean drinking water to over 10 million people throughout India. The project utilizes a community cost-sharing approach for the operation and sustainable management of the systems. The systems are specially designed, low-cost water

filters deployed in more than 250 communities across the country, enabling sustained supply of drinking water to all. Ongoing research includes water quality and monitoring, water resource management, interventions to enhance community readiness to adopt technological solutions, and identifying socio-economic characteristics of affected populations in the context of water epidemiology.

IoT System For Solar Based Rural Electrification



Mothakara, a remote village in the Wayanad district, Kerala, is inhabited by a tribal population of 40 families comprising around 260 people in 42 huts. In September 2014, Amrita performed complete electrification of this tribal village, to enable further improvements in social, economic, and educational areas. The University provides training to the local community, as a means to self-dependence, which can be remotely monitored and managed from the Amrita's Amritapuri campus. Researcher at Amrita plan to replicate its success in several other villages across India through the Amrita Self Reliant Village project (Amrita SeRve) led by the Mata Amritanandamayi Math.



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