NAHEP-CAAST-VNMKV-DFSRDA

INFORMATION BROCHURE

AGRI-BOT DIVISION

**NAHEP-CAAST-DFSRDA:
BRINGING DIGITAL FARMING EXCELLENCE THROUGH FOSTERING STUDENTS,
TEACHERS, ENTREPRENEUR AND FARMERS BY
AGRI-BOTS, AGRI-DRONES AND AGRI-AGVS**

**Dr. Gopal U. Shinde
Principal Investigator (PI)**

National Agricultural Higher Education Project
**CENTRE OF EXCELLANCE : DIGITAL FAMING SOLUTIONS FOR ENHANCING
PRODUCTIVITY BY ROBOTS, DRONES AND AGVS**

**Vasantrao Naik Marathwada krishi Vidyapeeth Parbhani,
Maharashtra (INDIA)**
www.nahep.vnmkv.org.in

INTRODUCTION

AGRI-BOT DIVISION

Agribots are the customized skeleton equipped with various devices like Robotic Arms, Sensors, Artificial Intelligence kits, batteries. The robots are of two types i.e. Mobile Robot and Stationary Robot. These are Electro-mechanical devices. Agricultural Robotics is the logical proliferation of automation technology into bio-systems such as Agriculture, Forestry, Green house, Horticulture. In agriculture, the opportunities for robot-enhanced productivity are immense - and the robots are appearing on farms in various guises and in increasing numbers. We can expect the robots performing agricultural operations autonomously such as spraying and mechanical weed control, fruit picking, scouting, mapping of farms at day & night for an effective report, allowing farmers to reduce the environmental impact, increase precision and efficiency, and manage individual plants in novel ways. The applications of instrumental robotics are spreading every day to cover further domains, as the opportunity of replacing human operators provides effective solutions with return on investment. This is especially important when the duties, that need be performed, are potentially harmful for the safety or the health of the workers, or when more conservative issues are granted by robotics. Heavy chemicals or drugs dispensers, manure or fertilizers spreaders, etc. are activities more and more concerned by the deployment of unmanned options.

The idea of applying robotics technology in agriculture is very new. In agriculture, the opportunities for robot-enhanced productivity are immense - and the robots are appearing on farms in various guises and in increasing numbers. We can expect the robots performing agricultural operations autonomously such as spraying and mechanical weed control, fruit picking, watching the farms day & night for an effective report, allowing farmers to reduce the environmental impact, increase precision and efficiency, and manage individual plants in novel ways.

The applications of instrumental robotics are spreading every day to cover further domains, as the opportunity of replacing human operators provides effective solutions with return on investment. This is especially important when the duties, that need be performed, are potentially harmful for the safety as well as health of the workers, or when more conservative issues are granted by robotics. Heavy chemicals or drugs dispensers, manure or fertilizers spreaders, etc. are activities more and more concerned by the deployment of unmanned options.

Agri-bot Division Objectives:

I. Establishment of laboratories training hall, training material, manuals of Agri-bots.
II. Preparation and Publication of digital tutorials, books, articles and leaflet and extension material for NAHEP-VNMKV Centre.
III. NAHEP faculty/PG/Ph.D student's & Faculty capacity building program through National and International training, conference and workshop for Computing, IT and Mechanical engineering perspective.
IV. Development of course modules under Agribots, division for certificate courses.
V. Development and training of Students and Farmers for Entrepreneurship (Small Startups).
VI. Revenue Generation through Conducting CAD/CAM/CAE Courses, Grafting of Plants.

COURSE MODULE FORMULATED
DFSRDA AGBOT: FIRST SEMESTER (COURSE STRUCTURE)

Subject Code	Subject Name	Teaching Scheme			Examination Scheme								
		Hours per Week		No. of Credits	Theory					Practical			
		Theory	Practical		Duration of Paper (Hrs.)	Max. Marks University Assessment	Max. Marks Internal Assessment	Total Marks	Min. Passing Marks	Max. Marks University Assessment	Max. Marks Internal Assessment	Total Marks	Min. Passing Marks
DFSRDA-AGBOT-101	Fundamentals of Agri-BOT	04	-	2	3 Hrs	80	20	100	40	-	-	-	-
DFSRDA-AGBOT-102	CAD/CAM in Agri-BOT	04	-	2	3 Hrs	80	20	100	40	-	-	-	-
DFSRDA-AGBOT-103	Agri-BOT Mechatronics	04	-	2	3 Hrs	80	20	100	40	-	-	-	-
DFSRDA-AGBOT-104	Agri-BOT Computing	04	-	2	3 Hrs	80	20	100	40	-	-	-	-
DFSRDA-AGBOT-105	Agri-BOT Maintenance	04	-	2	3 Hrs	80	20	100	40	-	-	-	-
DFSRDA-AGBOT-107P	Mini Project	-	02	1	2 Hrs	-	-	-	-	25	25	50	25
DFSRDA-AGBOT-108P	Mechatronics Lab	-	02	1	2 Hrs	-	-	-	-	25	25	50	25
DFSRDA-AGBOT-109P	Image Processing Lab	-	02	1	2 Hrs	-	-	-	-	25	25	50	25
DFSRDA-AGBOT-110P	Sensors, Actuators and PLC Lab	-	02	1	2 Hrs	-	-	-	-	25	25	50	25

DFSRDA-AGBOT:SECONDSEMESTER(COURSESTRUCTURE)

Subject Code	Subject Name	Teaching Scheme			Examination Scheme								
		Hours per Week		No. of Credits	Theory					Practical			
		Theory	Practical		Duration of Paper (Hrs.)	Max. Marks University Assessment	Max. Marks Internal Assessment	Total Marks	Min. Passing Marks	Max. Marks University Assessment	Max. Marks Internal Assessment	Total Marks	Min. Passing Marks
DFSRDA-AGBOT-201	Agri-BOT in CDKS	04	-	2	3 Hrs	80	20	100	40	-	-	-	-
DFSRDA-AGBOT-202	Agri-BOT in SSPN	04	-	2	3 Hrs	80	20	100	40	-	-	-	-
DFSRDA-AGBOT-203	Agri-BOT in SPM	04	-	2	3 Hrs	80	20	100	40	-	-	-	-
DFSRDA-AGBOT-204	Agri-BOT in FPA	04	-	2	3 Hrs	80	20	100	40	-	-	-	-
DFSRDA-AGBOT-205	Elective-I	04	-	2	3 Hrs	80	20	100	40	-	-	-	-
DFSRDA-AGBOT-206	Elective-II	-	02	2	3 Hrs	80	20	100	40	-	-	-	-
DFSRDA-AGBOT-207P	Major Project	-	04	2	4 Hrs	-	-	-	-	50	50	50	50
DFSRDA-AGBOT-108P	Agri-BOT Hardware Lab	-	02	1	2 Hrs	-	-	-	-	25	25	50	25
DFSRDA-AGBOT-109P	Agri-BOT Software Lab	-	02	1	2 Hrs	-	-	-	-	25	25	50	25
DFSRDA-AGBOT-110P	CAD/CAM/CAE Lab	-	02	1	2 Hrs	-	-	-	-	25	25	50	25

Events/Achievements

NAHEP/CAAST Project "Centre of Excellence for Digital Farming Solutions for Enhancing Productivity by Robots, Drones and AGVs" was sanctioned by ICAR, New Delhi on dated 12th July 2019. The project work for the develop the excellence in the field of Education and Research Using the digital technology for PG/PhD and Faculty

Inauguration Ceremony of NAHEP Centre at VNMKV, Parbhani

NAHEP-CAAST-VNMKV-DFSRDA Team along with national coordinator

Planning Meetings with Knowledge Partners

One day planning meetings were organised with IIT Kharagpur and IIT Powai for mutual collaborative activities and Technology Transfer. The MOA were framed and signed between both Knowledge partners and NAHEP CAAST DFSRDA VNMKV Parbhani.

Meeting with Knowledge Partner-Indian Institute of Technology, Pawai, Mumbai regarding MOA

Meeting with Knowledge Partner - IIT Kharagpur regarding MOA

Brainstorming Workshop

Brain storming workshops were organized by NAHEP CAAST DFSRDA Centre's Core team Members and Staff Members for awareness amongst the students of various clooeges and departmennts of the affiliated colleges in VNMKV parbhani. The have participated very enthusiastically and shown their interest in the activities conducted by NAHEP CAAST DFSRDA Centre.

Brainstorming Workshop at Department of Horticulture, VNMKV, Parbhani.

Brainstorming Workshop at Department of Horticulture, VNMKV, Parbhani.

Brainstorming Workshop at Department of AICRP on Utilization of Animal Energy, VNMKV, Parbhani.

Brainstorming Workshop at Department of Agronomy, VNMKV, Parbhani.

Brainstormiong workshop for Deparment of Extention and Department of Agricultural Economics

International Workshop

The severity of global population and climate change necessitated for application of automation like Drones, Robotics automated, guided Vehicle (AGV's) Artificial Intelligence(AI) , Internet of Things(IoT), Information Technology (IT) in agriculture sector. Digital farming comprises applications of modern automation machines for clean sustainable growth of food for the rapid growth of population. Digital farming solutions are used for crop cultivation, growth monitoring , transportation and agricultural management applications. These advanced machines/devices are most useful in embedded farming activities right from nursery to post harvesting process and can be more effectively used in IoT. So, there is need to understand what is digital farming solutions and their applications in the agriculture field for researchers, faculty/students to develop and enhance in the agricultural productivity.

**Moments in "Digital Farming Practices by Agribots, Agridrones and AgriAGVs"
from 13th March to 15th March 2020**

International Seminar (Online) on "Digital Technologies for Smart Agriculture: A Futuristic Plan" from 10th August to 13th August, 2020

The NAHEP CAAST-DFSRDA Parbhani centre is engaged in development of human resources in the area of agriculture through various academic, research and extension activities for students, scientists and faculties. As a part of this, various online Training programmes, Seminar and other activities are being planned and conducted during COVID-19 pandemic lockdown Period. In this regard, it is proposed to organize International Seminar in collaboration with **ISA-Parbhani chapter** and **ISGPB-Parbhani chapter** entitled **"Digital Technologies for Smart Agriculture: A Futuristic Plan".** The proposed International Seminar will cover the recent advances and Robotic Technologies used in the discipline of Agronomy and Agricultural Botany which will benefits students and faculties of all relevant disciplines of agriculture. This training includes theory, research based lectures were delivered by identified experts from various national and international organizations.

| Date	Speaker Name	Subject
10.08.2020	Prof. Dr. PARAG CHITNIS Director, USDA, NIFA, USA	Keynotes Speech on "Global Scenario for Smart Agriculture"
	Prof. Dr. MOSTAFA AL KURDI Director of Tyre Campus, American University of Technology, Lebanon	Smart Farming and Precision Agriculture by using UAV and UGV Robots
11.08.2020	Prof. Dr. PAVEL NAVITSKI Associate Prof. Engineering Department Oral Roberts University Tulsa, Oklahoma, USA	Digital Technologies for Plant Protection in Precision Farming
	Prof. Dr. MIKHAIL TATUR Byelorussian State University of Informatics and Radioelectronics, Minsk, Belarus	SMART- Agriculture Educational Process for Specialists Belarus to India
12.08.2020	Prof. JESZAEL CRISTOPHER Agricultural Science Faculty, National University of Rosario, Argentina.	Artificial Intelligence: Genetics Algorithms Applied to Optimization of Mechanization Systems
	Dr. LAV. R. KHOT Agricultural Automation Engineering, Department of Biological Systems Engineering, Washington State University, WSU, USA.	Precision Agriculture and Automation Technologies for Specialty Crop Production Management
13.08.2020	Prof. Dr. LABAD RYMA Department of Agronomy, Ferhat Abbas University –Sétif- Algeria.	Advanced Automated Herbicide Applicator Machineries in Algeria
	Dr. V. PRAVIN RAO Hon. Vice Chancellor, PJTSAU, Hyderabad, India President, ISA, New Delhi	Keynote Speech 1
	Dr. P. K. GHOSH National Director and Hon. Vice Chancellor, NIBSM, Raipur, Chhattisgarh, India	Keynote Speech 2
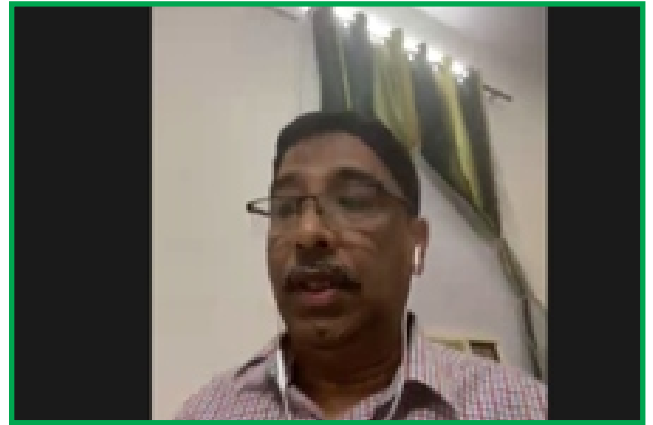
Hon. VC Dr. A.S. Dhawan and Dr. Prabhat Kumar addressing the Gathering
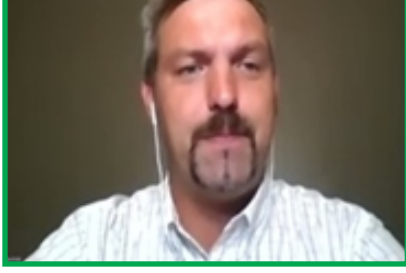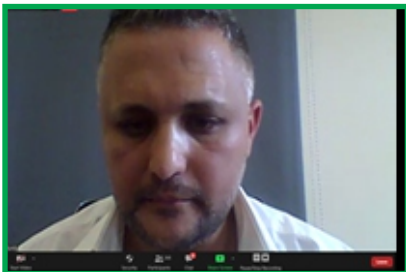
Eminent Speaker in online International Seminar
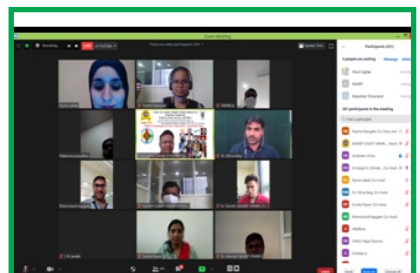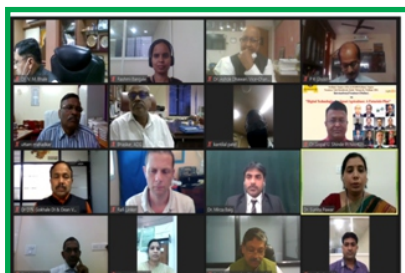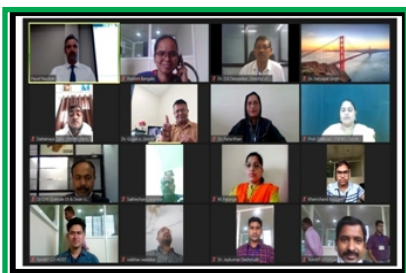
Participant in Online International Seminar
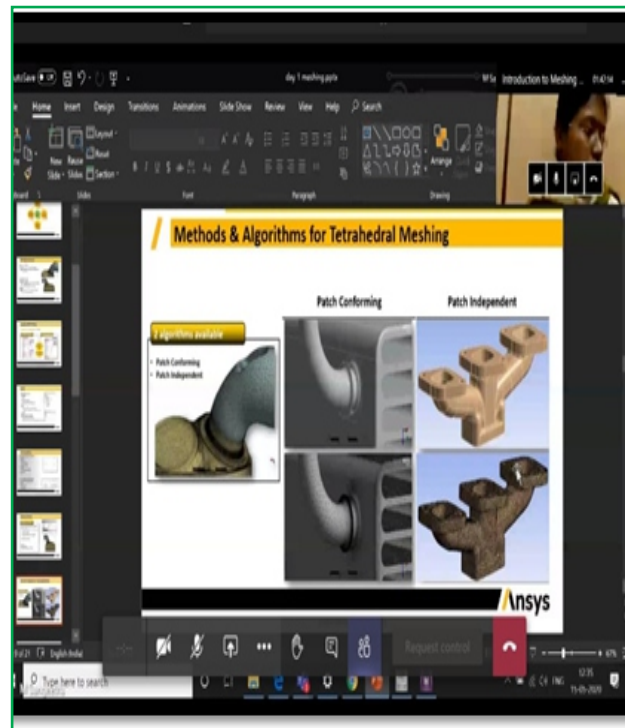
"Two Week National online training course on "Basic practices of ANSYS 2020 R1 (Computation Software) in Agriculture" from 12th May to 29th May 2020

Power of Digital Manufacturing (3D printing) for New Product

Development" from 20th June, 2020 (One Day Online Training)

"सुदृढ पर्यावरणसाठी कृषि रसायनाचा संतुलित वापर"
(Safe use of Agricultural Chemicals for Sustainable Environment) (In Marathi)

Industrial Visits under Agri-bot division:

3D Printing Demonstration at Big Zero Technology, Pune

Short visit at PDKV, Akola

Short visit to Mahesh Cold Storage Plant, Parbhnai

Short Visit to Robotics Laboretory at VNIT Nagpur

CENTRE OF EXCELLENCE FOR DIGITAL FARMING SOLUTIONS FOR ENHANCING PRODUCTIVITY BY ROBOTS, DRONES and AGVs. VASANTRAO NAIK MARATHWADA KRISHI VIDYAPEETH, PARBHANI (M.S.) INDIA Contact No. 02452_223002, 223802 Mob. 9422111232 Email: nahep.caast.vnmkv@gmail.com www.vnmkv.org.in ; www.nahep.vnmkv.org.in

Former Vice Chancellor Dr. V. M. Mayande

ISAE-President Dr. Indramani

54th ISAE Convention and International Conference on Artificial Intelligence in Agriculture

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Dr. Lav Khot , WSU, Washington USA

Dr. ROSNAH, Dr. Balasubramyam Malaysia

Dr. Tyae Sam, Nigeria

Dr. Hazarika, AIT Bangkok Thailand

Dr. John Reid ,John Deere, USA

Information about Agri-bot Division lab/Equipment's

1. 3D Printer

A 3D printer F170 is the world's most reliable range of industrial-grade. Designed for the way you work, It is built on 30 years of research and development by a team of engineers, designers, educators and manufacturers. That means 100% accuracy, engineering grade outputs and repeatable results. Every time.

The F170 works with a range of materials – so you can produce complex parts with flexibility and accuracy. And it includes advanced features like Fast Draft mode for truly rapid prototyping, and soluble support to prevent design compromise and hands-on removal. All designed to shorten your product development cycle and keep you ahead of the competition.

The F170, support a range of capabilities and budgets. F170 provides a solution for every stage of your work cycle, from prototypes to manufacturing floor solutions.

A 3D printer F170 delivers:

Minimal setups – simply plug and print. Give your entire workgroup access to professional industrial grade 3D printing.

Non-stop printing – spend less time troubleshooting and more time getting results.

Fast and easy material swaps –maximize your team's productivity.

Reliable results – high levels of accuracy and repeatability, with engineering grade materials.

Streamlined workflow – Go directly from CAD file formats to 3D print with GrabCAD Print software.

The detail specifications for the A 3D printer F170 are listed below:

PRODUCT SPECIFICATIONS

System Size and Weight	F120: 889 x 870 x 721 mm (35 x 35 x 29 in.), 124kg (275 lbs) F170, F270, F370: 1,626 x 864 x 711 mm (64 x 34 x 28 in.), 227 kg (500 lbs) with consumables
Noise Specification	46 dB maximum during build, 35 dB when idle

Layer Thickness

	0.330mm (0.013 in.)	0.254mm (0.010 in.)	0.178mm (0.007 in.)	0.127mm (0.005 in.)[1]
PLA	○	●	○	○
ABS	●	●	●	●
ASA	●	●	●	●
PC-ABS	●	●	●	●
ABS-ESD7™	○	●	○	○
Diran™ 410MF07	●	●	●	○
FDM™ TPU 92A	○	●	○	○

Accuracy[2]	Parts are produced within an accuracy of +/- .200 mm (.008 in), or +/- .002 mm/mm (.002 in/in), whichever is greater.
Network Connectivity	Wired: TCP/IP protocols at 100 Mbps minimum 100 base T, Ethernet protocol, RJ45 connector Wireless-ready: IEEE 802.11n, g, or b; Authentication: WPA2-PSK, 802.1x EAP; Encryption: CCMP, TKIP
System Requirements	Windows 7, 8, 8.1 and 10 (64 bit only) with a minimum of 4GB RAM (8 GB or more recommended)
Operating Environment	Operating: Temperature: 59 – 86 °F (15 – 30 °C), Humidity: 30 – 70% RH Storage: Temperature: 32 – 95 °F (0 – 35 °C), Humidity: 20 – 90% RH
Power Requirements	100–132V/15A or 200 – 240V/7A. 50/60 Hz
Regulatory Compliance	CE (low-voltage and EMC directive), FCC, EAC, cTUVus, FCC, KC, RoHs, WEEE, Reach

	F120	F170	F270	F370
Available material	ABS-M30™, ASA, QSR™ Support material	PLA[3], ABS-M30, ASA, TPU 92A, QSR Support material	PLA[3], ABS-M30, ASA, TPU 92A, QSR Support material	PLA[3], ABS-M30, ASA, PC-ABS, TPU 92A, QSR Support material
Build tray dimension	254 x 254 x 254 mm (10 x 10 x 10 in.)	254 x 254 x 254 mm (10 x 10 x 10 in.)	305 x 254 x 305 mm (12 x 10 x 12 in.)	355 x 254 x 355 mm (14 x 10 x 14 in.)
Material Bays	2 total (external) 1 model / 1 support	2 total 1 model / 1 support	4 total 2 model / 2 support	4 total 2 model / 2 support
Software	GrabCAD Print™	GrabCAD Print	GrabCAD Print	GrabCAD Print Insight™

2. 3D Scanner

With Artec Eva lite 3D Scanner Scanning, you can now achieve the very best in scanning results also using your own software, integrating Artec Eva into almost any system. Either adapt your current software to support Eva, or develop your own software to spec. Whether you want to scan for medical purposes, industrial quality control, or reverse engineering, Eva can be easily assimilated into your specialized solution. Artec Eva lite 3D Scanner can also be used with Artec L2, a 3D scanner with a wider field of view, specifically developed for built-in scanning solutions.

A details specifications for Artec Eva lite 3D Scanner are listed below:

Extremely versatile: Scan a broad range of objects with Artec Eva Lite. Use Eva for medium to large objects and Space Spider for small objects

Fast and accurate: Eva scans fast, capturing and simultaneously processing up to two million points per second with up to 0.1mm accuracy

Speed and precision: Artec Space processes up to one million points per second and produces images of extremely high resolution (up to 0.1 mm) and superior accuracy (up to 0.05 mm)

Target free: No object preparation needed. Start scanning from the word go

Easy integration: Integrate Artec Eva into your own scanning system using Artec Scanning SDK

Portability: Lightweight and battery compatible, you can take Artec scanners anywhere. The Artec battery pack provides power for up to 6 hours of scanning

Safe to use: Artec scanners employ structured light technology and are totally safe for scanning people

Tablet compatibility: Scan with a tablet for greater mobility

Real-time scanning: Frames are automatically aligned in real time

High resolution: Scan in brilliant colour and high resolution (Eva up to 0.5mm)

3D video mode: Scan a moving object and record a real-time 3D video

Bundling: Several scanners can be bundled together and synced to scan larger objects automatically

3. CAD/CAM/CAE Lab

A well-furnished and highly comfortable CAD/CAE lab is established by NAHEP-CAAST-VNMKV, Parbhani under Agri-bot division. A Maximum Licenced User having capacity 26 users can perform design & Analysis at the same time. In the Agri-bot CAD/CAE Lab available types of Analysis are listed below,

1. ANSYS space claim
2. Structural Analysis
3. CFD (Computational Fluid Dynamics) Analys
4. Fluid Flow (CFX)
5. Eigen Buckling Analysis
6. Model Analysis
7. Harmonic Response
8. HFSS (High Frequency Structure Simulator)
9. Maxwell 2D and 3D Analysis
10. Fluid Flow (Fluent) Analysis
11. Thermal Analysis
12. Thermal Electric Analysis
13. Steady State Thermal Analysis
14. Electric Analysis

In that the application areas are,

1. Farm Machinery
2. Irrigation Equipment's
3. Small Portable Machinery
4. Seed/Seedling Processing and Nursery Automation
5. Food Processing Automation Equipment's
6. Farm Structures
7. Agri-Robots Components
8. Agri-Drones Components
9. Agri-AGVs Components

4. Cotton Picking Robot

A cotton picking robot is highly précised robot operated on the principal of artificial intelligence and pneumatic suction pressure of 70mm of Hg. The battery operated self-steering wireless joystick operated AGV is used for effective handling of the robotic arms. The robotic arms are control by programming through RASPHBERRY PIE Controller.

5. Clear path Jackel J100 Robot

Jackal is a small, fast, entry-level field robotics research platform. It has an onboard computer, GPS and IMU fully integrated with ROS for out-of-the-box autonomous capability. As with all Clearpath robots, Jackal is plug-and-play compatible with a huge list of robot accessories to quickly expand your research and development

6. Huskey 200™ Starter Package Robot

Husky is a medium sized robotic development platform. Its large payload capacity and power systems accommodate an extensive variety of payloads, customized to meet research needs. Stereo cameras, LIDAR, GPS, IMUs, manipulators and more can be added to the UGV by our integration experts. The Husky's rugged construction and high-torque drivetrain can take your research where no other robot can go. Husky is fully supported in ROS with community driven Open Source code and examples.

7. Grafting Robot

An automat grafting robot has been developed by NAHEP-CAAST-DFSRDA-VNMKV, Parbhani under Agri-bot division. Which can implement clipping, moving, positioning, cutting, binding, and wrapping rootstock and scion saplings. An Experimental results indicate that the grafting success rate of this robot is 87.3% and the binding success rate is 68.9%
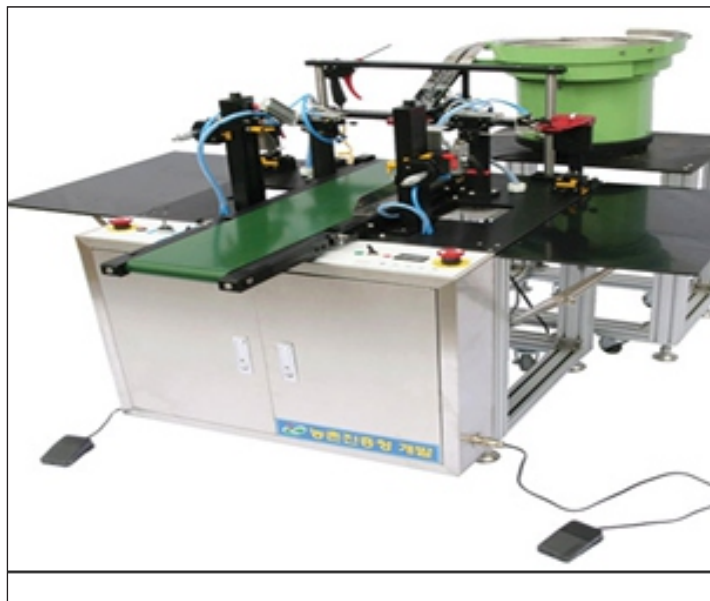
InaugurationCeremony

NAHEP-CAAST-VNMKV-DFSRDA Team along with national coordinator

Demo of Agri-Drone infront of NAHEP-CAAST-VNMKV Team

NAHEP VNMKV Centre Parbhani MoU with Chatrapati Shahu College of Engineering Aurangabad MS India

Meeting with Knowledge Partner - IIT Kharagpur regarding MOA

Brainstorming Workshop at Department of Horticulture, VNMKV, Parbhani.

Brainstorming Workshop at Department of Horticulture, VNMKV, Parbhani.

GIS Training for Faculty

ISAE 54th Annual Convention and International Symposium on Artificial Intelligence Based Technologies in Agriculture

ISAE Annual Convention and International Symposium on Artificial Intelligence Based Technologies in Agriculture

3D Printing Demonstration at Big Zero Technology, Pune

3D Printing Demonstration at Big Zero Technology, Pune

Brainstorming Workshop at Department of Agronomy, VNMKV, Parbhani.

Demo of Agri-Drone for Spraying application at the Department of Agronomy

Brainstormiong workshop for Deparment of Extention and Department of Agricultural Economics

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Demo of Robotnic Robot at NAHEP-CAAST-DFSRDA Centre.

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