



The Shirpur Education Society's

**R. C. Patel College of Engineering and
Polytechnic, Shirpur**

Department of Mechanical Engineering

NAME OF COURSE: - Emerging Trends in Mech Engg

CODE OF COURSE: - 315363

SEMESTER: - ME-5K (TYME)

**Unit - 5 Recent Trends in Agriculture
Engineering
16 Marks**

SUBJECT TEACHER

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Unit 5 = Recent Trends in Agriculture Engg.

5.1} Automation in agriculture = (Smart farming)Introduction =

Automation in agriculture means utilization of recent technologies such as sensors, cameras, drones, robots, AI ~~at~~ algorithms, IoT & automated machines to perform agricultural activities with minimal human resources. Main motive is to improve productivity, reduce dependence from human workers, optimum use of other resources etc.

Demand for agricultural products increases as population increases, adversely farmers face problems like shortage of workers, land etc. To meet the demand it is essential for farmers to adopt automation in agriculture. It reduces need of workers, help to monitor crop health, irrigation, application of fertilizers properly, & harvesting.

Need of automation in agriculture =

- 1) Unavailability of skilled workers.
- 2) Increased labour cost.
- 3) Increment in food demand due to uncontrolled population growth.
- 4) Climate change & unpredictable weather conditions.
- 5) Requirement for achieving high food quality.
- 6) Reduction in harvesting losses (Pre & Post harvesting).
- 7) Cost & Time efficiency.

Automated farm ~~robots~~ = equipments =#} Agri robots =

Agri robots are automated machines designed to perform many agricultural activities with very less

or no human interference. Technologies such as sensors, cameras, GPS, IoT, AI & ML algorithms are used to improve productivity, accuracy & efficiency of agricultural activities.

These robots help farmers by reducing labour cost, increasing crop yield, minimizing wastage of resources & by performing repetitive tasks accurately with high precision.

Types of agri robots =

- 1) Harvesting robots
- 2) Inspection & monitoring agri. robots.
- 3) Automatic seeding & planting machines.
- 4) AI operated irrigation systems.

1) Harvesting robots =

Harvesting robots are fully or semi-automatic agriculture machines designed for identify, pick, collect & sort agri-product (crop) with very less human intervention. Recent technologies such as Sensors, cameras, GPS, autonomous navigation, AI & ML algorithms are deployed to harvest crop efficiently & precisely. Harvesting robots help to reduce labour cost, reduce crop loss & improve productivity.

Types of Harvesting robots =

i) Fruit harvesting robots =

- Fruits such as oranges, apples, mangoes, peaches, tomatoes etc can be harvested precisely.
- Uses high definition cameras & AI to identify fully grown fruit (ripe fruit)

- Robotic arm picks the fruits without damaging it.
- ii) Vegetable harvesting robot =
 - Vegetables such as cabbage, broccoli, cucumbers, peppers etc can be harvested precisely.
 - Cutting mechanism provided with robot to cut leaves properly & then keep it without any damage.
- iii) Grain harvesting robot =
 - Harvesting of grain such as rice, wheat, maize, soyabean, can be performed precisely.
 - It can automatically perform activities like grain cutting, threshing, cleaning & collecting grains safely.
- iv) Root crop harvesting robots =
 - Harvesting of potatoes, carrots, onions, beetroot, can be performed precisely & without damaging.
 - Sensors are used to monitor digging, holding, lifting & storing crops precisely.
- v) Grape harvesting robots =
 - These are specially designed for harvesting grapes.
 - It can automatically detect the clusters and harvest them with high precision.

Benefits of harvesting robots =

- i) Increased harvesting speed & efficiency.
- ii) Reduce labour cost & dependency.
- iii) Precise harvesting.
- iv) Minimum wastage & damage to crop.
- v) Improvement in quality of crop.
- vi) Can be work continuously (Day & night)
- vii) Collect & analyze data for precision agriculture.
- viii) High crop yield & high profitability.
- ix) Reduced operators fatigue.

xii) promotes sustainable farming practices.

Workflow of harvesting robot =

- i) Field navigation
- ii) Crop detection
- iii) Robotic arm positioning
- iv) Harvesting
- v) Collection.
- vi) Sorting & Quality inspection
- vii) Data management.
- viii) Storage.

2) Inspection & monitoring agriculture robots =

These robots are fully automatic or semi-automatic use to close observation, inspection, & monitor crops, soil, livestock & other conditions. To collect real time data these robots are equipped with sensors, HD cameras, GPS, AI & ML & communication channel. By use of these robots farmers can able to identify problems at their early stage, helps to take necessary steps to improve crop health, & to increase productivity.

Types of Inspection & Monitoring Agricultural robots =

i) Ground inspection robots =

- They can move with the help of wheels or track provided in agricultural field.
- Cameras, GPS, LiDAR and various sensors are installed on it for monitoring & inspection.
- Capable of inspecting crop growth, weeds, pests & soil condition.

ii) Aerial monitoring robots = (Drones)

- Agricultural drones can fly over the field with the help of GPS to monitor crop health.
- Capture images & videos using HD camera.
- Able to cover very large area in less time

iii) Soil monitoring robots =

- With the help of sensors, these robots can detect moisture content in soil, nutrients & composition of soil.
- Manages optimum level of water, nutrition content in soil.
- Collect soil samples from different locations in field for better view.

iv) Green house monitoring robots =

- These robots use to detect standard environmental condition required inside of green house.
- Continuously moves inside greenhouse to monitor conditions & communicate it with proper channel.

Workflow of inspection & monitoring robots =

- Robot uses predefined paths using GPS navigation.
- Advance sensors, cameras collect all necessary data required.
- The collected data communicated to processors through communication channels.
- AI process all the data received.
- All information with summary & suggestions were informed to farmer through mobile applications.
- From above information with suggestion, farmer can initiate required corrective action.

Benefits of inspection & monitoring robots =

- i) Detects diseases at their initial stages,
- ii) Provide real time data regarding crop growth,
- iii) Detects pest early, so farmer can initiate required steps.
- iv) Improves the yield.
- v) Reduces workers, as all work of inspection & monitoring can be done by robots.
- vi) Proper utilization of resources like water, fertilizers & pesticides.
- vii) Helps to take efficient decision.
- viii) Increases profitability & overall efficiency of farm.

3) Automatic seeding & planting machine =

Increased or decreased crop yield depends on how seeds or seedlings are placed into the soil at optimum depth, spacing, & row alignment. Automatic seeding & planting machine ~~are~~ are advance machines use to sowing seeds or seedling with high accuracy.

These machines are equipped with powerful sensors, cameras, GPS for navigation & AI ensures precise planting with minimal human intervention. In addition these machines reduces labour cost & increases crop productivity.

Types of seeding & planting machine =

i) Automatic seed drill =

- To sow seeds in continuous rows & at optimum depth these machines used.
- Reduces seed wastage through uniform spacing.
- Best suited for crops like wheat, cotton, soyabean, etc

ii) Precision planter =

- Sows seeds individually at optimum depth & equal spacing.
- Tends to grow crop equally. (Uniformity in plant population).

iii) Rice Transplanter =

- Flooded fields required to grow plant & grow rice.
- This machine automatically transplants seedlings at optimum depth & equal spacing.

ix) Vegetable transplanter =

- Seedlings of vegetables are planted automatically using these machines.
- Best suited for seedlings of nursery grown.
- Tomato, cabbage, chiller, Brinjal etc

v) Robotic seeding machine =

- Robotic seeding machine uses camera, GPS, robotic arm & AI for doing work automatically.
- By analysing the condition of soil precisely it plants the seeds.

vi) Drone based seed planting system =

- These type of drones are used to restore forest, grassland etc.
- In this system drones are used to disperse seeds over targeted area.
- Very large area can be covered using drones in short time span.

Work flow of automatic seeding & planting machines =

i) Field navigation

- ii) Seed metering
- iii) Furrow opening.
- iv) Seed placement.
- v) Covering.
- vi) Compacting.
- vii) Monitoring seed flow, spacing, m/c performance.

Benefits =

- i) Accuracy is maintained while planting seeds with correct seed depth & spacing.
- ii) Results in maintaining uniformity in growth of crop.
- iii) Large fields also covered in short time period.
- iv) Reduction in workers.
- v) Reduction in wastage of seeds.
- vi) Increases plant population & productivity.
- vii) Production cost requires less due to reduced labour & input costs.
- viii) Machines consistently working with minimal ~~errors~~ errors results in increased efficiency.
- ix) Collects data regarding location, seed rate, and other information for future ~~purp~~ use purpose.

4) AI operated irrigation systems =

It is intelligent system that deploys Artificial intelligence, IoT, smart sensors, real time data to supply optimum amount of water to crops at right time. With the help of modern sensors system continuously monitors soil & environmental conditions, use data analytics to process collected data & automatically controls irrigation, it improves efficiency & productivity of crop.

Types of AI operated irrigation system =

i) AI based drip irrigation system =

- Use of AI algorithms to adjust flow of water to crops as per soil & environment condition.
- AI controls water flow through drippers for optimum water supply.
- Best suited for fruits, vegetables, vineyards & greenhouse farming.

ii) Crop based AI irrigation system =

- AI determines requirement of water on basis of crop, stage of growth, with the help of large datasets.
- Automatically supply water based on requirement.
- Best suited for multi-crop farming & horticulture.

iii) Soil moisture based AI irrigation system =

- Smart sensors used in this system to detect moisture content in soil.
- AI receives the data & process it. Automatically starts or stop water flow based on required moisture level.

iv) Weather based AI irrigation system =

- By knowing weather conditions & forecasting like chances of rainfall, change in temperature, humidity, wind speed, AI determines the need of irrigation.
- AI automatically adjusts irrigation schedule according to weather conditions.
- Best suited for large fields.

Benefits of AI operated irrigation systems =

- ### i) Proper & efficient utilization of water =
- Water can be supplied as per requirement, reduces the wastage of water.

ii) Automation in irrigation = Based on feedback from sensors regarding moisture content in soil & environmental condition, system automatically starts & stops the supply of water.

iii) Reduced labour requirement = Requires minimal human intervention for monitoring & operating.

iv) Improvement in growth = Provides required amount of water when needed, resulting in healthy growth of crop.

v) Remotely operated = Monitoring, operation can be performed by App on mobile phone.

vi) High crop yield = Healthy crop can produce more ~~pro~~ yield with quality.

vii) Weather based irrigation = Manage water supply based on environmental condition as well as weather forecasting.

viii) Smart irrigation = Data from sensors can be analysed by AI to prepare schedule for irrigation.

5.2) Autonomous Tractors = (Self driving tractors)

Autonomous tractor is smart machine can able to perform various operations with very less or no human intervention. It uses GPS, modern sensors, cameras, AI for ~~navigation~~ navigation, collision avoidance & accuracy in operations.

These machines can design to follow predefined paths and perform various operations such as ploughing (गिराई), sowing, spraying, & harvesting etc.

Working =

- Using GPS tractor follow the predefined path with accuracy.

- Cameras & smart sensors detect the field condition as well as obstacles if any.
- Data from smart sensors are communicated with control system. Control system processes the data.
- Processed data now fed to AI. AI determines the appropriate movement & sends ~~correction~~ signals to actuators ~~for~~ if corrections needed.
- Actuators can control ~~on~~ speed of tractor & steering movement automatically.
- Remote monitoring = farmer can observe the operations through mobile application. Can make changes in route if required.

Types of autonomous Tractors =

- ① Fully autonomous
 - No human requires to drive tractor.
 - Controlled through mobile app.
- ② Semi-autonomous =
 - Requires small attention of human but can operate automatically for specific tasks.
 - Driver can take over in any emergency condition.

Features of autonomous tractors =

- GPS navigation.
- Automating steering control.
- Detects obstacle if any.
- Implementation of AI for decision making.
- Remotely monitored.
- Automatic route planning.
- Real time data collection, processing & storing for future purpose.
- Safety systems.
- Easily integrates with farm management system.

Benefits of autonomous tractors =

- i) Reduction in labour requirement.
- ii) Accuracy & systematic operations.
- iii) Improved fuel consumption.
- iv) Can perform all operations day & night.
- v) Auto correction for continuity in route.
- vi) Reduction in seed wastage, pesticide, fertilizer wastage.
- vii) Improvement in safety.
- viii) Reduction in operational cost.
- ix) Improved data management.

5.3) Agricultural drones = (Agricultural UAVs)

Agri. drones also known as agricultural UAVs (Unmanned Aerial Vehicles). These drones can be utilized in farm activities like soil/field analysis, crop monitoring, planting, seeding, spraying etc. They are equipped with sensors, GPS, camera, AI & mechanisms for various purposes. These drones can be controlled by human operators or fly autonomously to perform all operations efficiently.

Soil & field analysis =

With the help of GPS drones can fly over targeted area & captures HD images, also collect other important information regarding soil condition & share it to the controller for further action.

These drones are capable of preparing HD maps, identify variations in moisture & fertility, detect waterlogging area, identifies deficiency in nutrients, measure field elevation & drainage patterns etc.

Crop monitoring =

This is very important function performed by drones. Drones provide HD images of field & data from various sensors regarding health & growth of crop. Drones can keep close watch on crop & provide detailed insights that can be very difficult to obtain through conventional methods.

Drones can monitor crop growth, detect diseases and pest attacks, identify water logging, early detect damages to the crop, monitors the effect of pesticides, fertilizers on crop growth, etc.

Plantation =

Agricultural drones have significantly improve the efficiency & accessibility of plantation process. Using conventional methods for plantation is difficult to access when we ~~apply~~ talking about very large scale farming.

- Drones are capable to storing a fixed amount of seeds in it.
- Using GPS, drones detect the exact location for plantation.
- Controller takes decisions regarding rate of seed release and location.
- locations are already feeded to controller
- Continuously data can be stored for further use.

Crop spraying =

Crop yield ~~dis~~ depends on factors like quality of soil, availability of water, availability of nutrition, pest attacks & diseases on crop etc. Drones can help farmers to stay disease free & stay safe from

pest attacks using spraying pesticides, herbicides, fertilizers & other important crop protection chemicals.

Working =

- Drones are capable in storing fixed amount of spraying material.
- Predetermined paths/area provided to drones before actual action.
- GPS & HD maps ~~navigates to~~ help to identify spraying area.
- Sensors provide stable movements of drone.
- Nozzles spray the required amount over the crop.
- The rate of spraying can be adjusted as per the field condition.

These drones can reduce the wastage of (fertilizers) & spraying material, reduce chances of poisoning to workers, can reach to all locations easily & without any damage to crop etc.

Advantages of agricultural drones =

- i) Time saving technique.
- ii) Less labour requirement.
- iii) Improvement in crop monitoring through mobile app.
- iv) Reduces wastage of water, fertilizers, pesticides & other crop protection chemicals.
- v) Detects pest attacks, diseases at their early stage.
- vi) No physical damage to crops.

- vii) Easily reach to all locations where tractors can not reach easily,
- viii) Improvement in crop yield.
- ix) Collects vast data for planning & decision making

x) Farmers can able to monitor & operate drone from safe location through mobile app.

xi) Use of drones reduces the pollution that can be done by excess use of chemicals, pesticides etc.

Government schemes for drone usage =

Govt of India promotes use of drones in various field in all over ~~country~~ through SMAM (Sub mission on agricultural mechanism). SMAM is implemented by state government & now it is part of Rashtriya Krishi Vikas Yojana (RKVY).

Govt of India provides subsidies for drone purchase and also provides drone service to farmers.

Beneficiary	Financial assistance
ICAR institutions, Govt institutions.	100% of drone cost upto 10 lakh lakh.
Farmer producer org (FPO) for demonstration	upto 75% of drone cost
Custom hiring centres (CHCs)	40% upto 4 lakh.
Agri. graduates establishing CHCs	50% upto 5 lakh
Small & marginal farmers (SMT)	50% upto 5 lakh.
Other individual farmers	40% upto 4 lakh.

Other govt. schemes =

1) Pradhan mantri Krishi Sinchae Yojana
(PMKSY)

Purpose = To improve irrigation system & agricultural productivity.

2) National agricultural market (e-NAM)

Purpose = Provide better mechanism to link markets for farmers.

3) Kisan drone scheme =

Purpose = Promote use of drones in agriculture.

4) Digital Sky platform = Provide

Purpose = To provide framework for regulating use of drones.

5) Drone shakti scheme =

Purpose = Promotes use of drone technology in agriculture & in rural areas.

6) PM Gati shakti national master plan.

Purpose = To improve infrastructure, connectivity, transportation & logistics across all over India.

7) Namo drone didi scheme.

Purpose = Women's self-help groups get support to buy agricultural drone & can provide service to small farmers to get paid for that.

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