Development of IoT, Drone and AI based Agriculture Monitoring System

(Sponsored by Ministry of Electronics and Information Technology, Govt. of India)

Nature of Project:

The project is related to design and development of IoT, Drone based agriculture monitoring system to enhance the quality and productivity of farming land. In addition, we also aim to train the students in IoT, Drone and AI and provide complete infrastructure to students to complete their various projects in the area of smart IoT board, Drone design and AI.

Objective of the Project:

- To train the students in IoT, AI and Drone technology, thus making them technically skilled and ready for the Industry employment and their own start-ups.
- Infrastructure Set-up to provide hands-on training/teach the courses beyond the syllabus.
- Measurement of Drone Air to Ground (AG) propagation Channel at 2.4 GHz and 5.8 GHz.
- Health monitoring of crops, weed identification in the mid of the fields, crop fertility rate monitoring and sprinkling pesticides using drone.
- Optimization of Drone path and height.
- IOT, AI and Drone Integrated System.

Detailed Description of the Project:

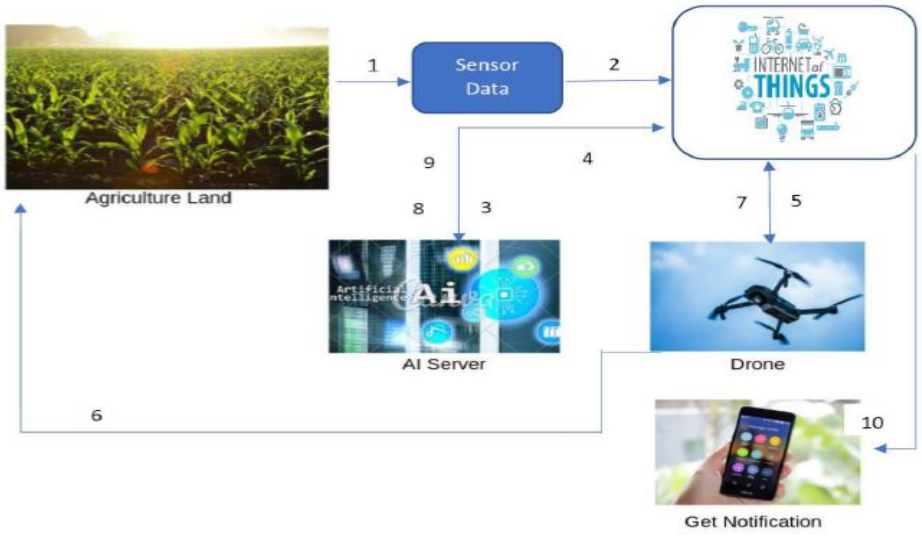


Fig.1 Smart agriculture system.

The project has three-fold objectives. The first part is to train the students of SC community in the area of IoT, AI and Drone technology, thus making them technically skilled and ready for the Industry employment and their own start-ups. Secondly, the work is aimed to develop smart agricultural system using IoT, Artificial Intelligence (AI) along with drone system. The model will use Unmanned Arial Vehicle (Drone) to monitor the agricultural land where different kind of sensors such as soil moisture, humidity, pressure and temperature sensors etc have been deployed. The data collected by the sensor will be sent to AI server through IoT. Apart from this, satellite data will also be considered as an input in the AI system. AI will, then, analyze the sensor and satellite data and it will prioritise the monitoring requirement of crops by drone. Now, the drone will monitor the crops condition on the priority basis and will send the information to AI server. Finally, AI will analyze the cause and problem and it will pass on the solution to the concerned person for rectification. In addition to this, we will also carry out Drone Air-to-Ground Channel measurement at 2.4 GHz and 5.8 GHz to assess the potential for high data rate communication capability of drone to Gateway link. The third part of the project is to impart training to the local community (farmers) to use the technology to be developed in the project and to make them familiar as to how their crop productivity and quality can be improved through the proposed technology.

Name of production agencies willing to productionise / use and market Surveys:

1. Krishi Vigyan Kendra, (Govt. of UP) Gorakhpur (N. D. Univ. of Agriculture & Technology, Kumarganj, Faizabad, Govt. of UP).
2. Central Electronics Limited (CEL), Ghaziabad.
3. DIGI Toad Technologies, Bangalore.
4. PRITHVI AI LAB, IIT Kanpur
5. RCPL, Kanpur
6. Digital Design Solutions
7. Texas Instruments (TI)
8. Design, Innovation and Incubation Centre (DIIC), MMMUT, Gorakhpur
9. NAVIDIA Technology

Benefits:

- Training provided to young Engineers will make them more employable. The students will be more equipped with state-of-the-art technology in the emerging area of IoT and Machine learning.
- The trained students can go for start-up.
- Can join as technical experts in different IoT application industries for repair, servicing and installation of IoT devices.
- Can join as an Engineer in different types of agro-industries.
- Transfer the learned skills to project design. This will enable the students to go for research-oriented projects.
- AI and robotics, has impacted all industries, including education. So its batter opportunity to make future in IT sector. For example, A recent report from IBM,

Burning Glass and Business Higher Education Forum shows that the number of job opportunities for data and analytics skills will increase by 364,000 to 2,720,000 in 2020.

- It is about finding the right resources for all students, using AI virtual assistants such as Alexa, Bixby, Google and Siri.
- The sustainable development of the IoT also grabbed the attraction of the government and it has also been planned to open an IoT research centre. So students can move to government sector.
- Use Drones to Develop Children Motor Skills And Hand-Eye Coordination.
- Use Drones In PE (Physical Education) Class
- Use Drones For Speaking And Writing Exercises

List of Projects to be taken by Students

Experiment List based on Smart Board/Sensors

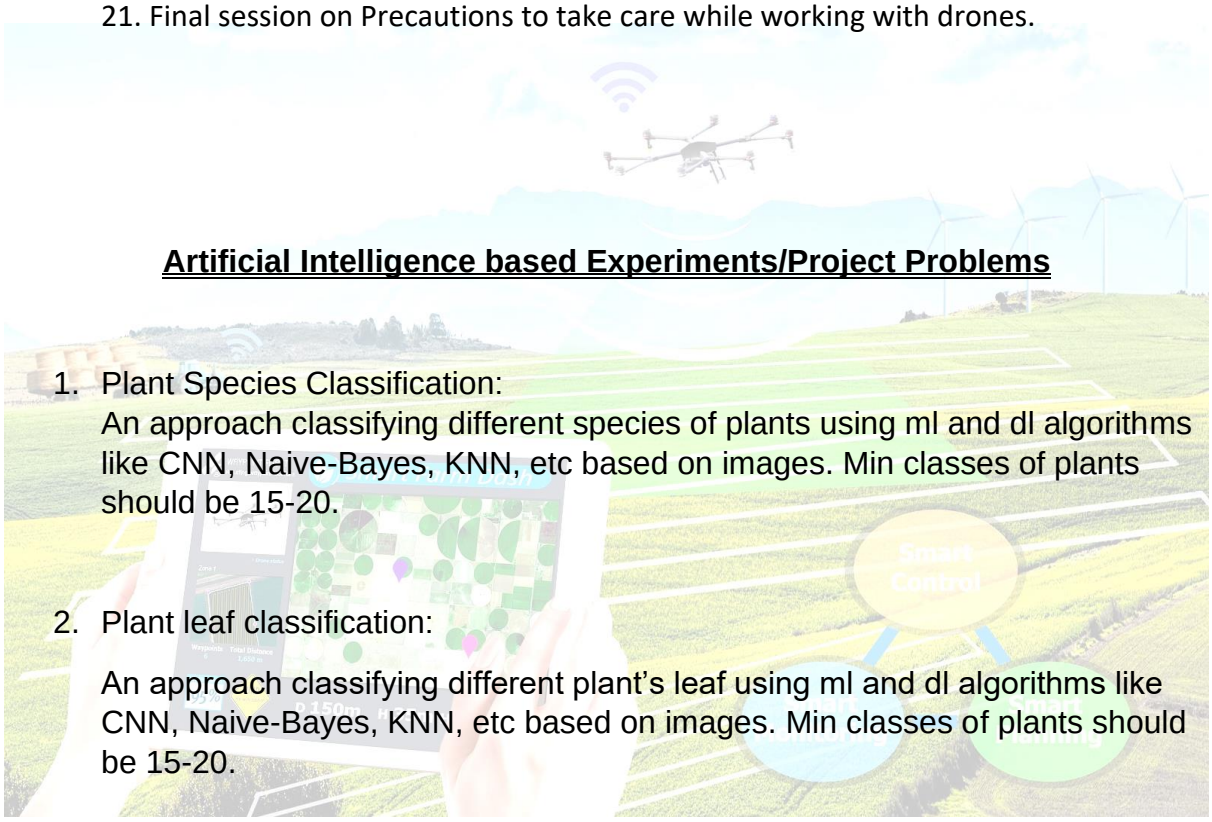
1. Introduction to Embedded systems & Internet of things.
2. Design, development and verification of Embedded and IoT Development Boards.
3. Development of customized IoT Board.
4. Introduction to General purpose input output peripherals and differentiation in digital & analog data verification.
5. Introduction to Different type of motors- interfacing with development board and Speed/ Direction control of DC Motor from microcontroller.
6. Circuit implementation for driving DC Motor from microcontroller using L-293D.
7. Introduction to Timers and understanding the concept of pulse width modulation to production signal of various duty cycle.
8. Understanding of display devices & architecture overview and interfacing with Development board to visualize the data on LCD devices.
9. Introduction to the concept of Analog to digital conversion and understanding the effect of bit size on the output data.
10. Concept of sensor calibration and using sensors in digital & analog mode as per project requirement.
11. Introduction to IR sensor and Interfacing with microcontroller to display results on LCD.
12. Introduction to DHT11 and interfacing with Microcontroller and displaying on LCD to analyse Humidity and temperature data.
13. Introduction to LDR sensor and interfacing with microcontroller and displaying on LCD to analyse the light intensity at different interval of time and generating chart for the same.
14. Introduction to PH sensor and interfacing with microcontroller and displaying on LCD to analyse the different PH values in different soil samples.
15. Introduction to the concept of UART and implementing on Microcontroller to send & receive the dummy data.
16. Introduction to Raspberry Pi and architecture overview & understanding the concept of I/O peripherals.
17. Understanding the different data transmission protocols between Raspberry pi and Embedded devices.

18. Introduction to the concept of MQTT and understanding the design architecture to communicate between different nodes available on field.
19. Introduction to different camera modules available in market and understanding the application requirement for desired output.
20. introduction to the concept of computer vision and application design.
21. Introduction to Unmanned Aerial System (UAS) components and understanding different configurations, characteristics and applications.
22. Introduction to design and development of Multi Rotor Vehicles.
23. Understanding the Electronics circuitry involved in Quadrotor & Learn about Stability and Control of Drones.
24. Introduction to Accelerometer and Gyroscopes for motion control and Understanding on-board flight control and payload factors.
25. Machine Learning in Agriculture: Applications and Techniques

Drone based Experiments:

1. Introduction to flying machines. What are quadcopters, hexacopters, octocopters.
2. Introduction to Brushless Motors, Electronic Speed Controllers, Flight Controllers, LiPo Battery, radio transmission system, video transmitter, telemetry system with live view of each thing.
3. Simulation and modelling of Drone prototype.
4. Design and Development of Drone body component using 3D printer and related software.
5. Live Demonstration of Brushless Motor running with ESC and how to make connections between them.
6. Quadcopter Dynamics. The Physics related behind flying of a drone and Session on types of propeller and which propeller to use.
7. Live Demonstration of changing motor direction and speed with ESC.
8. How does the Flight Controller communicates with the ESC and different kinds of prototocols used (PWM, OneShot125, Oneshot42, MultiShot, Dshot).
9. How does the Radio receiver communicates with the ESC and different kinds of protocols used (PWM, PPM, SBUS).
10. Sensors used in the Drone (gyroscope, accelerometer, magnetometer, barometer and GPS) and introduction to 3D coordinate system.
11. Live Demonstration of sensor data from drone and how the sensor data is used to calculate Angles in the drone.
12. Introduction to PID Control System and live Demonstration of tuning PID parameters with stability model.
13. Use of Video transmitters and receivers along with telemetry transmitters and receivers and how to make connections.
14. How to setup gimbal in a drone along with live demonstration.

15. Session on different flight modes of a drone (Acro, Auto Level, Altitude Hold, Headless Mode, Position Hold, RTH).
16. Live Demonstration of setting everything up in software, how to calibrate sensors and how to make drone ready to fly using Ardupilot software.
17. Live Demonstration on how to setup safety features in drone including low battery, radio lost, telemetry lost.
18. Live Demonstration Flight Session and different flight modes and demonstration of Mission Planner software and how to use Mission Planning for autonomous flights.
19. Live Demonstration of how to receive live video from drone on laptop or mobile.
20. Live Demonstration of how to send and receive data to and from the drone and how to control drone using telemetry system using mobile or laptop.
21. Final session on Precautions to take care while working with drones.



Artificial Intelligence based Experiments/Project Problems

1. Plant Species Classification:
   An approach classifying different species of plants using ml and dl algorithms like CNN, Naive-Bayes, KNN, etc based on images. Min classes of plants should be 15-20.

2. Plant leaf classification:

   An approach classifying different plant's leaf using ml and dl algorithms like CNN, Naive-Bayes, KNN, etc based on images. Min classes of plants should be 15-20.

3. Health level prediction of a crop:

   Predicting the health/growth of a crop based on time duration using various parameters like humidity, temperature, etc of at least 10 species.

4. Controlling the use of pesticides in Agriculture:
   Prediction of quantity of pesticides required for a particular crop based on various parameters which effect the need of pesticides.

5. Live monitoring of crop:
   Live monitoring of crop includes the cation generation or prediction

Of what is happening in the farm where the crops are and taking the live images from the camera.

6. Flower Classification:
   An approach classifying different flowers using ml and dl algorithms like CNN, Naive-Bayes, KNN, etc based on images. Min classes of flowers should be 15-20.

7. Live monitoring of soil health:

   Live motoring the soil is required so that we can prevent it from diseases or any other factor which affects the crop growth badly. Therefore, live prediction of soil health is required. Build a model so that live monitoring of soil health can be checked.

8. Tree classification:

   An approach classifying different trees using ml and dl algorithms like CNN, Naive-Bayes, KNN, etc based on images. Min classes of trees should be 15-20.

9. Predicting Timber Rates:
   Timber's price and quality vary based on size, its use and species. While keeping in mind the stated or some other characteristics predict the price of the given timber.

10. Prediction of quality of seeds:
    Gathering the quality of seeds before farming is very important to know. Therefore, prediction model has to be build that can predict the overall quality of seeds.

11. Prevention of crop diseases and providing solution:
    Crop disease are very common while farming and in agriculture. So that what if a model can be made which tell the upcoming disease of the plant before it can damage the crops based on various parameters.

12. Plant diseases Classification:
    Classifying diseases plaguing a plant such as onion or money plant. Classify at least 5 diseases.

13. Crop Maturity Prediction:

Predicting whether the crop is ready for harvesting or not depending on various parameters which affects it.

Some Research Based Problems

1. Measurement of signal strength between LoRaWAN Gateway and LoRaWAN node for LOS and NLOS scenario.
2. Development of Drone-Gateway system using LORaWAN technology and signal strength measurement in LOS and NLOS conditions.