MINISTRY OF AGRICULTURE AND FARMERS WELFARE

NATIONAL BANK FOR AGRICULTURE AND RURAL DEVELOPMENT

NABARD

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AGRISURE GREENATHON

Team Details

- Team Name: **Cultivatetech**
- Team Leader Name: **Tanushree K**
- Problem Statement: **Build an IoT-based irrigation system that ensures optimal water and nutrient delivery to crops**

Brief about the idea:

A smart irrigation system uses IoT technology to efficiently manage water use in agriculture. It employs sensors to monitor soil moisture, temperature, and humidity, connecting with a microcontroller like Arduino to process data. The system automates water distribution based on real-time conditions, minimizing waste and enhancing crop yields. Users can control and monitor it remotely via a smartphone app or web interface, improving convenience and decision-making. Benefits include water conservation, cost efficiency, and improved agricultural productivity. Future enhancements could involve integrating weather forecasts, using solar power, and applying machine learning for predictive analysis, further optimizing resource use and sustainability.

Opportunities:

The smart irrigation system conserves water, reduces costs, and scales from small gardens to large fields, integrating with other smart technologies.

Differentiation:

It uses real-time data and adaptive scheduling, minimizing human error and ensuring precise watering.

Problem-Solving Capability:

The system reduces water wastage, improves plant health, and enhances labour efficiency.

Unique Selling Proposition (USP):

With advanced sensors, ease of use, and environmental sustainability, it offers cost-effective, precise, and efficient water management, making it a standout solution.

List of features offered by the solution

Here's a list of features commonly used in smart irrigation system:

Hardware Components:

- Arduino Uno board
- Soil Moisture Sensor (e.g. YL-69 or FC-28)
- Water Pump or Solenoid Valve
- Breadboard and Jumper Wires
- Power Supply (e.g. 9V battery or wall adapter)

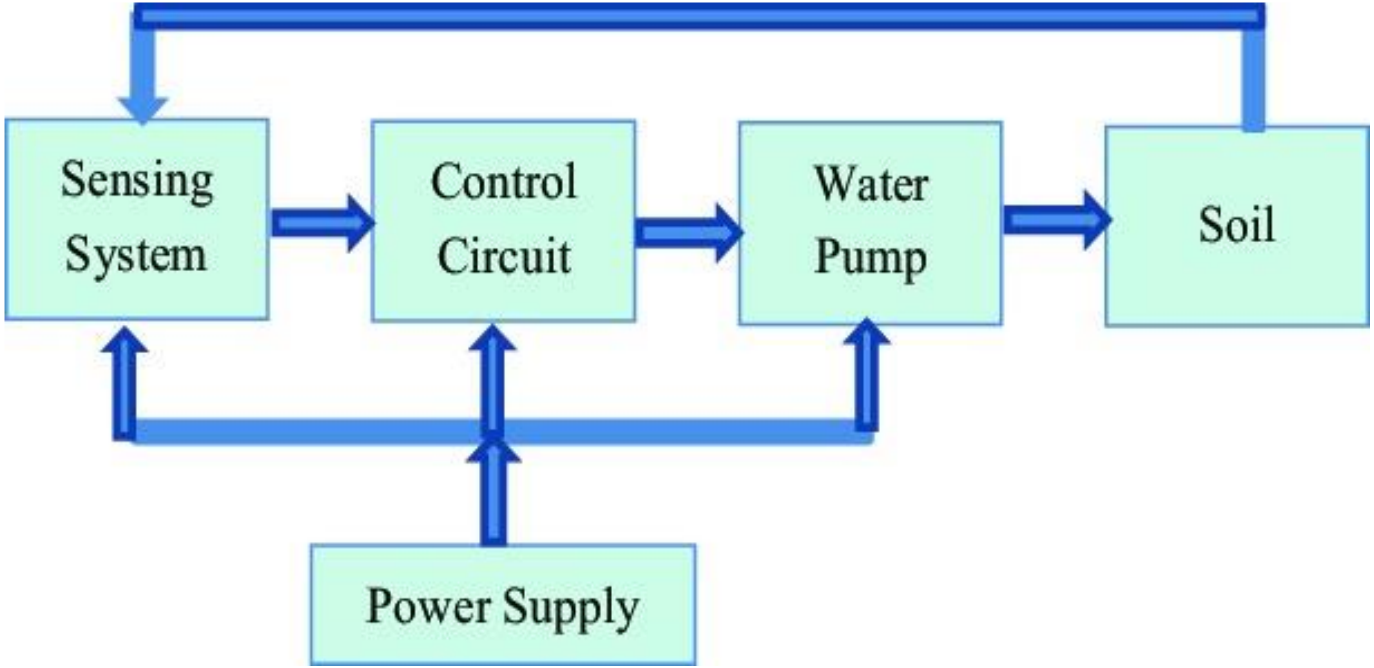
Software Features:

- Arduino IDE for programming the Arduino Uno board
- Automatic water pump or solenoid valve control

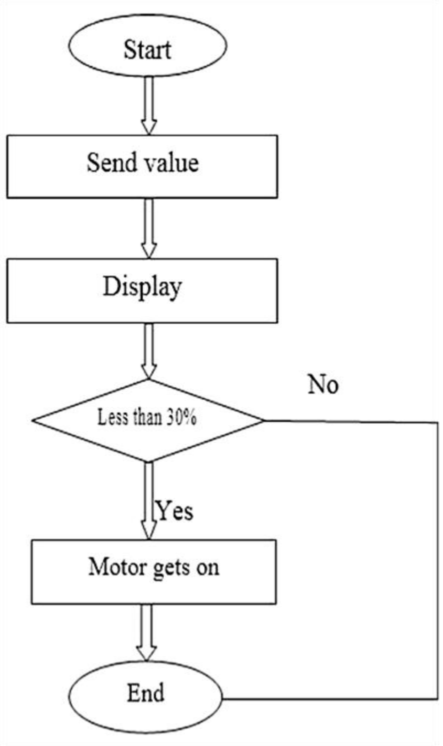
Functional Features:

- Automatic irrigation system that waters plants when soil moisture falls below a set threshold
- Real-time monitoring of soil moisture levels using the serial monitor or an LCD display
- Manual override feature to allow users to water plants manually.

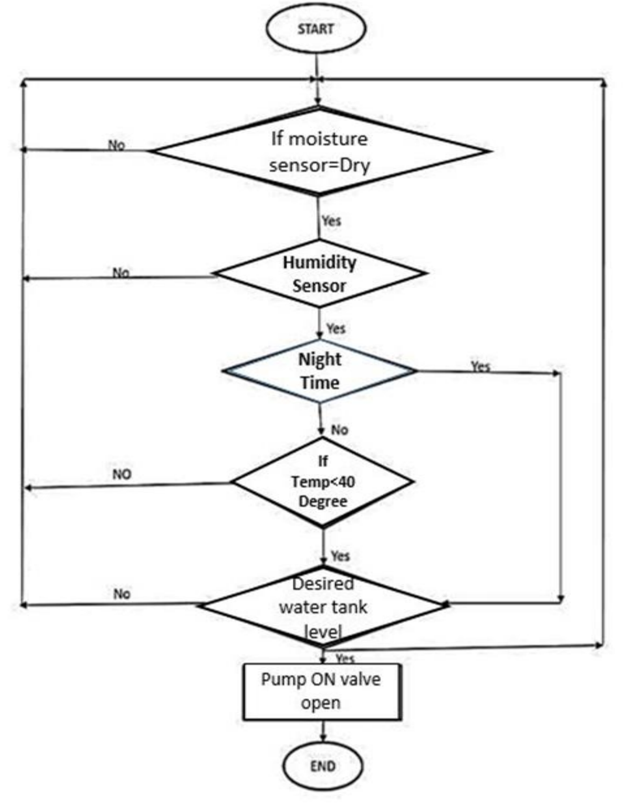
Process flow diagram or Use-case diagram



flow diagram :

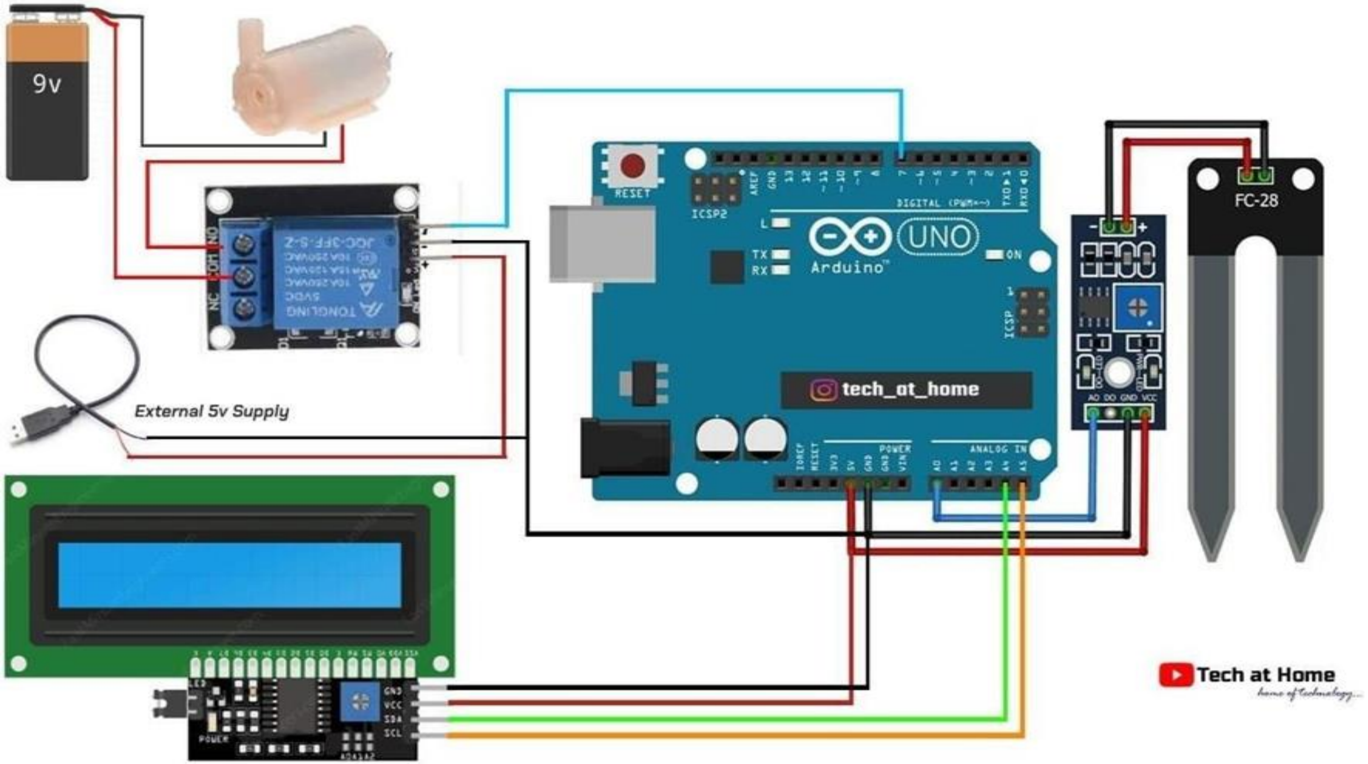


Soil moisture sensor



Process implementation

Architecture diagram of the proposed solution



Technologies to be used in the solution

- **Communication and Connectivity**:
  Wi-Fi or Bluetooth Module: Integrating a WiFi (e.g., ESP8266) or Bluetooth module enables wireless connectivity for remote monitoring and control of the irrigation system via a smartphone app or web interface.

- **Software Development**:
  Arduino IDE: Used for programming the Arduino Uno to implement the logic for automatic watering, sensor data handling, and communication protocols.
  Web Technologies: If developing a web interface, technologies such as HTML, CSS, JavaScript, and backend frameworks (e.g., Node.js) may be used.
  Mobile App Development: For a smartphone app, languages like Java (for Android) would be applicable.

- **Data Handling and Analytics**:
  Data Logging: Store sensor data over time to analyze trends and optimize watering schedules.

- **User Interface**:
  LCD Display: Provides real-time feedback on soil moisture levels and system status directly at the setup.
  Web Interface or Mobile App: Allows users to monitor and control the irrigation system remotely, view historical data, and adjust settings.

Estimated implementation cost (optional)

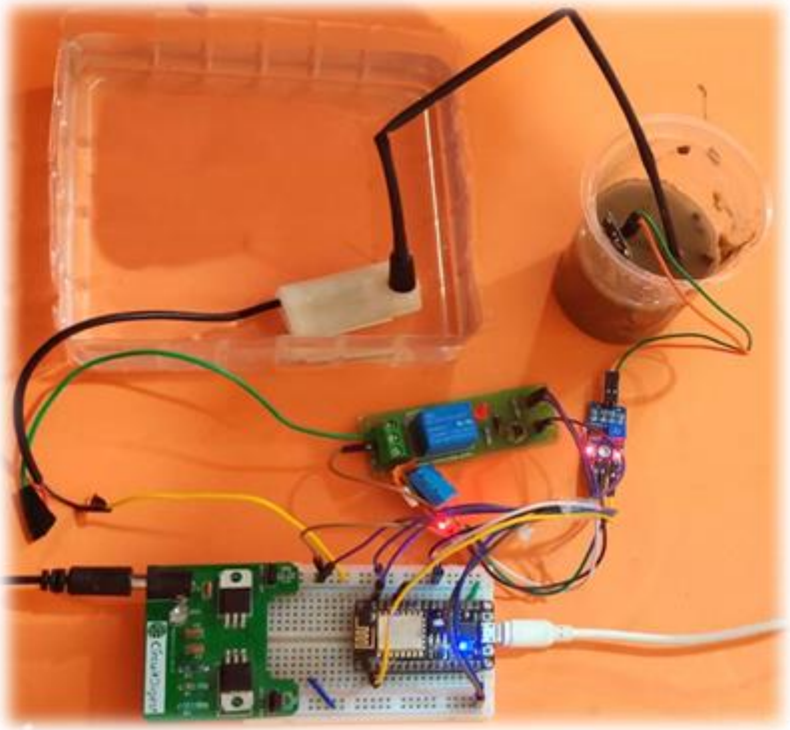
1. **Hardware Components**:
1. Arduino Uno board: ₹1,500
2. Soil Moisture Sensor (YL-69 or FC-28): ₹300 - ₹600 each (depending on quality and quantity)
3. Water Pump or Solenoid Valve: ₹750 - ₹1,500
4. Breadboard and Jumper Wires: ₹300 - ₹600
5. Power Supply (e.g., 9V battery or wall adapter): ₹300 - ₹600

2. **Software Development**:
1. Arduino IDE (free)
2. Programming Time: Estimate developer hours for coding and testing.

3. **Additional Costs**:
1. Prototyping materials and tools: ₹1,500 - ₹3,000 (for tools, soldering iron, prototyping boards, etc.)
2. Testing and calibration: ₹1,500 - ₹3,000 (for sensors calibration and system testing)
3. Documentation and miscellaneous expenses: ₹1,000 - ₹2,000

Total Estimated Implementation Cost (in INR):
•**Low End Estimate**: ₹8,150 (basic components, minimal additional costs)
•**High End Estimate**: ₹13,800 (higher quality components, additional tools and testing)

Snapshots of the prototype



Prototype Performance report/benchmarking

Hardware Evaluation:

Components used: Arduino Uno, soil moisture sensor, solenoid valve.
Integration and reliability assessment.

Software Evaluation:

Programming in Arduino IDE.
Functionality: Automatic watering, real-time monitoring, manual override.

Performance Metrics:

Water conservation: % reduction compared to traditional methods.
Energy efficiency: Power consumption metrics.
Accuracy: Soil moisture sensing precision.
Response time: Activation from low moisture detection.

Benchmarking Against Traditional Methods:

Comparison: Water usage, cost effectiveness.
Impact analysis: Environmental and economic benefits.

Additional Details/Future Developments

- **Wireless Connectivity**: Integrate Wi-Fi or Bluetooth modules (e.g., ESP8266 or HC-05) to enable remote monitoring and control via a smartphone app or web interface. This would allow users to check soil moisture levels and adjust watering schedules from anywhere.

- **Weather Integration**: Incorporate a weather API to receive real-time weather forecasts. This data can be used to adjust watering schedules based on upcoming rain or temperature changes, ensuring water conservation and plant health.

- **Data Logging and Analytics**: Implement data logging capabilities to record soil moisture levels, weather conditions, and watering events over time. Analytics can then be applied to analyze trends, optimize watering schedules, and identify potential issues with plant health.

- **Multi-zone Control**: Expand the system to support multiple zones or areas with different soil types or plant requirements. This could involve using multiple soil moisture sensors and valves controlled independently based on the specific needs of each zone.

•**Weather Integration**: Incorporate weather forecasts to adjust irrigation schedules automatically based on predicted rainfall and temperature changes.

•**Solar Power**: Implement solar panels to power the system, making it more sustainable and reducing reliance on external power sources.

•**Machine Learning**: Use machine learning algorithms to analyze historical data and predict future irrigation needs, improving efficiency.

•**Nutrient Monitoring**: Add sensors to monitor soil nutrient levels, allowing for targeted fertilization alongside irrigation.

•**Advanced Analytics**: Develop a dashboard for detailed insights and trends, helping farmers make data-driven decisions.

Conclusion

The smart irrigation system using Arduino and IoT effectively optimizes water usage by automating irrigation based on real-time data from soil moisture, temperature, and humidity sensors. This approach conserves water, reduces labor costs, and increases crop yield. The system's user-friendly interface allows remote monitoring and control via a smartphone app or web platform. It’s scalable, allowing easy integration of additional sensors and features. Future enhancements could include incorporating weather forecasts and solar power for greater sustainability. Overall, the project successfully demonstrates a practical, efficient, and sustainable solution for modern agriculture, promoting water conservation and improved farming practices.

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