

Tender Document

Preamble

This document outlines the technical specifications and requirements for the procurement of IoT-based sensors, devices, gateways, and related services. The tender is issued with the aim of implementing advanced IoT solutions for agricultural and environmental monitoring using LORA technology. The equipment and services to be procured shall comply with the specifications provided herein to ensure seamless integration and long-term reliability.

The scope of the tender includes supply, installation, and training for a range of IoT-enabled devices and sensors, alongside the necessary cloud platform support. All suppliers are required to adhere to the following conditions in addition to the product-specific specifications:

1. **Supplier Credentials:**
 - The supplier must be a member of the LoRa Alliance or authorized by a LoRa Alliance Member.
 - Prior experience in supplying similar IoT-based devices and successful project completions for government/private organizations is preferable.
 - Suppliers must demonstrate expertise in LoRaWAN technology through verifiable documentations.
2. **Technical Compliance:**
 - A detailed compliance report against the technical specifications must be submitted with the bid.
 - Datasheets for all proposed products must be provided.
3. **Quality Assurance:**
 - All equipment must meet IP protection ratings to ensure durability under environmental conditions.
 - Certification and documents for the products must be submitted.
4. **Project Execution:**
 - Installation and training services must be provided as part of the bid.
 - The supplier should have a proven track record in handling installations.
5. **Demonstration and Evaluation:**
 - Shortlisted bidders may be required to provide a presentation of their proposed solution.
6. **Cloud Platform Integration:**
 - The cloud platform provided must support seamless integration with the supplied devices, ensuring robust data security, analytics, and device management capabilities.

The tender aims to procure state-of-the-art IoT devices and infrastructure that align with the outlined specifications, meeting the technical and operational needs of the project. Bidders are encouraged to carefully review the detailed specifications of each item to ensure compliance and accurate submissions.

Subject: - Supply of components for design and development of Wireless Sensors Nodes to monitor and control parameters for smart farming tasks like automatic irrigation, ploughing, disease detection, weed detection etc

Scope of Work:

- a. To identify the predominant livelihood system for women in KOT Gautam Buddha Nagar Village and provide the solution for improving social entrepreneurs by doing organic farming integrating IoT, AI and Robotics.
- b. To develop sensor nodes for deployment in the field for data acquisition of soil nutrients, moisture level and environmental temperature and identify the crop cultivation.
- c. To develop an IoT/LoRa network for each identified farm land in the village for proper monitoring of fields remotely.
- d. To develop Multifunctional AI Robots and User Interface for seed sowing, irrigation, weed cutting, crop harvesting and post processing.
- e. To train the women SHGs of the KOT Village for using these Robots and user interfaces for organic farming and for packing of the products to make it market ready.

Outcomes:

- The pilot application will be developed on the sample land and then the project will be implemented in the KOT Village.
- Wireless Sensor node will be designed and deployed in the agriculture field for collecting soil and environmental parameters.
- AI based Multifunctional Robot for organic Agriculture will be developed.
- The deep learning algorithm for early detection of crop disease will be developed.
- Dedicated user interface for organic farming to be used by women SHGs.
- Market ready organic end products.

1. Solution Overview

Objective: To design and develop wireless sensor nodes that can monitor critical soil parameters (such as moisture, temperature, pH, and conductivity) and enable smart irrigation systems based on real-time data.

Outcome: Efficient water usage, improved crop yield, reduced labor, and data-driven farming decisions.

2. Components of the Wireless Sensor Node

Soil Sensors: These sensors would measure the required soil parameters like moisture, temperature, and conductivity. These could include:

- Soil Moisture Sensor (Capacitive or Resistive)
- Soil Temperature Sensor
- pH Sensor (if relevant)
- Conductivity Sensor

Microcontroller/Processor: A low-power microcontroller that can process sensor data and manage wireless communication.

ESP32, STM32, or similar microcontrollers are commonly used.

Power Supply: The node should be optimized for low power consumption and supported by solar or battery systems to operate in the field without needing frequent maintenance.

Wireless Communication: To transfer data to a central hub or cloud for processing, a wireless protocol needs to be selected:

LoRaWAN: Long-range and low power, suitable for agriculture.

NB-IoT: Cellular communication with low power usage.

Wi-Fi/BLE: If short-range communication is enough or nearby gateways are available.

Enclosure: Rugged and waterproof to withstand outdoor environmental conditions.

3. Smart Irrigation System

Control System: The wireless sensor node will trigger the irrigation system based on predefined conditions, such as soil moisture falling below a threshold.

Valve Control: Based on the sensor data, valves for irrigation can be automatically opened or closed.

4. Mentoring and Development Process

Mentorship Areas:

Hardware Design: Guidance on selecting the right sensors, microcontrollers, communication modules, and power management systems.

Firmware Development: Programming the microcontroller for sensor data acquisition and wireless communication.

IoT Integration: Setting up the network for remote data access, whether it's through cloud platforms or local servers.

Field Deployment: Testing the nodes in agricultural fields, optimizing power usage, and ensuring reliable communication.

Data Analytics: Developing analytics tools or dashboards to interpret sensor data and make decisions about irrigation timing.

Supply Chain: Provide the hardware components (sensors, microcontrollers, wireless communication modules) along with support for procurement of field-ready enclosures and accessories.

5. Implementation Support

Workshops & Training: Provide hands-on training on how to set up, deploy, and maintain the wireless sensor nodes.

Technical Support: Assist in troubleshooting, software upgrades, and integration with existing irrigation systems.

Prototype Development: Support building and testing prototypes before scaling up.

Technical Specifications

1. Gateway based on LPWAN for Outdoor usage – 2 Quantity

Specifications:

- LoRa® Spec: 1 x SX1308 + 2 x 1257 LoRa Transceiver or better
- Up to -140 dBm sensitivity with SX1250 Tx/Rx front-end
- 70 dB CW interferer rejection at 1 MHz offset
- Able to operate with negative SNR, CCR up to 9dB or better
- Emulates 49 x LoRa demodulators and 1 x (G)FSK demodulator
- Dual digital TX & RX radio front-end interfaces
- 10 programmable parallel demodulation paths
- Dynamic data-rate (DDR) adaptation
- True antenna diversity or simultaneous dual-band operation
- 10M/100M RJ45 Ports x 1
- WiFi : 802.11 b/g/n
- LoRaWAN Wireless
- Power Input: 12 ~ 24 V DC, 2 A
- IEEE 802.3 af compliant PoE port (DC 37 ~ 57 v)
- USB 2.0 host connector
- Mini-PCI E connector
- Fiberglass Antenna
- IP65 Enclosure or better
- Lighting Protection
- Power Adapter
- IP Enclosure
- Supplier should be a LoRa Alliance Member
- Supplier should have supplied same products to any Government organization and work orders need to be submitted

2. Water level Sensor based on LPWAN – 1 Quantity

Specifications:

- Flat object range 280mm - 7500mm or better
- Accuracy: $\pm (1 \text{ cm} + S * 0.3\%)$ (S: Distance) or better
- Measure Angle: 40° or better
- Cable Length: 25cm or better
- Ultra-low power consumption
- Distance Detection by Ultrasonic technology
- Support Bluetooth v5.1 and LoRaWAN remote configure
- Support wireless OTA update firmware
- AT Commands to change parameters
- Downlink to change configure
- IP66 Waterproof Enclosure
- 8500mAh Battery or better
- Supplier should be a LoRa Alliance Member
- Supplier should have supplied same

3. Leaf Moisture Sensor based on LPWAN – 4 Quantity
Specifications:

- Monitor Leaf moisture
- Monitor Leaf temperature
- Monitor Battery Level
- AT Commands to change parameters
- Support Bluetooth v5.1 and LoRaWAN remote configure
- Support wireless OTA update firmware
- Ultra-low power consumption
- LoRaWAN 1.0.3 Class A
- Uplink on periodically
- Downlink to change configure
- IP66 Waterproof Enclosure or better
- IP67 rate for the Sensor Probe or better
- 8500mAh Battery or better
- Supplier should be a LoRa Alliance Member
- Supplier should have supplied same products to any Government organization and work orders need to be submitted

4. Soil Moisture, Temperature & Electrical conductivity Sensor based on LPWAN – 4 Quantity

Specifications:

- Soil Moisture Range: 0-100.00% or better
- Soil Moisture Resolution: 0.01% or better
- Soil Conductivity Range: 0-20000uS/cm or better
- Soil Conductivity Resolution: 1 uS/cm or better
- Soil Temperature Range: -40.00°C~85.00°C or better
- Soil Temperature Resolution: 0.01°C or better
- Band: IN865
- Ultra-low power consumption
- LoRaWAN 1.0.3 Class A
- AT Commands to change parameters
- Uplink on periodically
- Downlink to change configure
- IP66 Waterproof Enclosure or better
- 8500mAh Battery or better
- Supplier should be a LoRa Alliance Member
- Supplier should have supplied same products to any Government organization and work orders need to be submitted

5. Soil pH Sensor based on LPWAN – 4 Quantity

Specifications:

- Monitor soil pH with temperature compensation

- Soil pH Range: 3 ~ 10 pH or better
- Soil pH Resolution: 0.01 pH or better
- Monitor soil temperature
- Soil Temperature Range -40°C ~ 85°C or better
- Soil Temperature Resolution: 0.1°C or better
- Monitor Battery Level
- Ultra-low power consumption
- LoRaWAN 1.0.3 Class A
- Default Band: IN865
- AT Commands to change parameters
- Uplink on periodically
- Downlink to change configure
- IP66 Waterproof Enclosure or better
- IP68 rate for the Sensor Probe or better
- 8500mAh Battery or better
- Supplier should be a LoRa Alliance Member
- Supplier should have supplied same products to any Government organization and work orders need to be submitted

6. IoT Cloud Platform with network server - 3 Years Validity

Specifications:

- Integrated LPWAN Network and Application Server with unified network management and application handling.
- Web Application and Android Mobile Application to visualize the Sensor Data and to control the actuators
- Need to support a Wide range of Technologies including LPWAN, MQTT, and HTTP
- Long-Range IoT Device Class Support: Class A & Class C
- Long-Range IoT Activation Method Support: ABP & OTAA
- Cloud Hosted with data security, and internal protocol adherence.
- Multi-channel notifications (E-Mail & Mobile App etc.) for efficient critical information dissemination.
- Versatile data export (Excel, CSV, PDF) for seamless data use across business processes.
- Scheduled reporting automates insights delivery for informed decision-making.
- Real-time device monitoring and control through intuitive dashboards.
- Scheduled and data-driven automated downlink to the devices.
- Option to provide manual override Downlink to end devices based on user decisions.
- Streamlined device and gateway management for registration, administration, and oversight.
- Proactive gateway status alerts for quick responsiveness to changes.
- Communication failure alerts for proactive intervention and maintenance.
- Application Specific data analytics dashboards.
- Third-party app integration via webhooks for external data processing.
- Should have user-friendly widgets to visually represent contextual device application

data.

- Should have fine-grained user management with roles and permissions for secure tailored access.
- Supplier should be a LoRa Alliance Member
- Supplier should have supplied same products to any Government organization and work orders need to be submitted

7. Temperature and Humidity Sensor Modules – 20 Quantity

Specifications:

- Temperature Range: 0°C to 50°C
- Humidity Range: 20% to 90%
- Resolution: Temperature and Humidity both are 16-bit
- Accuracy: $\pm 1^\circ\text{C}$ and $\pm 1\%$
- Operating Voltage: 3.5V to 5.5V
- Operating current: 0.3mA (measuring) 60uA (standby)
- Output: Serial data

8. Soil NPK Sensor based on LPWAN – 4 Quantity

Specifications:

- Monitor Soil Nitrogen
- Monitor Soil Phosphorus
- Monitor Soil Potassium
- NPK Range 1-1999 mg/kg or better
- NPK Resolution: 1 mg/kg or better
- Monitor Battery Level
- Default Band: IN865
- Ultra-low power consumption
- LoRaWAN 1.0.3 Class A
- AT Commands to change parameters
- IP66 Waterproof Enclosure or better
- IP68 rate for the Sensor Probe or better
- 8500mAh Battery or better
- Supplier should be a LoRa Alliance Member
- Supplier should have supplied same products to any Government organization and work orders need to be submitted

9. ESP32 based Wireless sensor node based on LoRa with soil sensor and Accessories - 20 Quantity

Specifications:

- CPU: Xtensa dual-core 32-bit LX6 microprocessor, up to 240MHz
- ROM: 448KB for booting and core functions

- SRAM: 520 KB for booting and instructions
- SRAM: 16 KB in RTC
- SPI Flash: 4MB
- Ultra Low Power (ULP) Co-processor
- Crystal oscillator: 40 MHz
- 8x Hybrid Digital IO with Special Functions
- Special Functions: 1x I2C, 1x SPI, 1x UART
- 4x Hybrid Analog & Digital IO: 4 No's
- 2x Hybrid Analog & Digital IN: 2 No's
- Analog Resolution: 8,10,12-bit configurable
- Pulse Width Modulation (PWM)
- Onboard Temperature Sensing (typ., -40°C to 90°C with Accuracy ± 0.3 °C)
- Onboard Humidity Sensing (typ., 0%RH to 100%RH with Accuracy $\pm 2\%$ RH)
- Onboard LED: 1xRED
- Bluetooth Classic and Bluetooth Low Energy (BLE) in the 2.4GHz band
- General ISM < 1GHz LoRa™ Transceiver 868MHz Surface Mount
- Onboard Antenna for Wi-Fi & Bluetooth

LoRa Specification:

- LoRa Chip: RF96
- Data Rate: 300kbps
- Power Output: 20dBm
- Sensitivity: -148dBm
- Current Transmitting: 120mA
- Operating Temperature: - 20°C ~ 70°C
- RF Family/Standard: General ISM < 1GHz
- Protocol: LoRa™
- Modulation: FSK, GFSK, GMSK, MSK, OOK
- Frequency: 865-867 MHz
- Antenna Type - External Antenna via SMA / I-Pex connector
- Supply Voltage: 1.8V ~ 3.7V
- Receiving Current: 12.1mA
- Transmitting Current: 120mA
- Operating Temperature: -20°C ~ 70°C

Wi-Fi:

- 802.11b/g/n
- Bit rate: 802.11n up to 150 Mbps
- A-MPDU and A-MSDU aggregation
- 0.4 μ s guard interval support
- Center frequency range of operating channel: 2412 ~ 2484 MHz

- **Bluetooth Specification:**
- Bluetooth v4.2 BR/EDR and BLE specification
- Class-1, class-2 and class-3 transmitter
- Adaptive Frequency Hopping (AFH)
- **Common DC Characteristics:**
- Supply Voltage: 5 V
- Operating Voltage: 3.0 - 3.6 V
- Minimum current delivered by power supply: 500 mA
- Battery Voltage: 3.7 V Li-Poly
- operating temperature range: – 40 °C ~ 85 °C
- Wake up from GPIO interrupt, timer, ADC measurements
- This development board should be both battery and power operated.
- 3.7V 2.6AH Battery
- Enclosure for the board for outdoor usage.
- Sensor required: Soil sensor module.
- Supplier should be a LoRa Alliance Member
- Supplier should have supplied same products to any Government organization and work orders need to be submitted

10. Soil Ph & NPK Sensor – 5 Quantity

Specifications:

- Output Signal: RS485
- Protection level: IP68
- PH measuring range: 3-9PH
- NPK measuring range: 0-1999 mg/kg
- RS485 to TTL Converter Module Serial Port UART

11. Support for PCB Design and Enclosure Design – 20 Quantity

- Suppliers must support the PCB Designing, Prototyping, Enclosure Designing & 3D Printing Services.

12. Industrial assistance for preparation of Prototype Model for Multifunctional Robot.

13. Robot components and tools for weeding, seeding, disease detection, Plant monitoring and spaying, harvesting, plant management.

14. Robotic vehicle for preparing the robot for cultivation of Garlic, Carrot, Fennel, and Turmeric crops.

15 Tablet as user interface

16. Printer

17. Laptop as server

18. Industrial assistance for Deployment of wireless sensor nodes and Robot in the field.

18. Installation and Training:

- Installation and training for the above products need to be provided by the bidder.

Buyer added Bid Specific Additional terms and Conditions:

- Bidders need to submit the technical specification compliance report.
- Suppliers must submit the Previous PO Copies of Similar items Supplied to any government/private organizations and LoRaWAN based Agriculture IoT PO Copies of any other Govt/private Labs.
- Suppliers need to provide the datasheets of the above products.
- The provider needs to be well-versed in LoRaWAN technology, relevant proof needs to be submitted.
- The trademark certificates for the products that are to be supplied must be submitted by the supplier.
- The supplier must have supplied LoRaWAN IoT Products for at least five years and work completion documents need to be submitted.
- Supplier must be a LoRa Alliance Member or Authorized by LoRa Alliance Members, related documents need to be submitted.
- Supplier Must have Good Experience in LoRaWAN Device Installations and Installation completion copies need to be submitted.
- The bidder will be called for presentation / demonstration during the technical evaluation.



Dr Gayatri Sakya
Principal Investigator
(SEED/WS/2023/643)

Expression of Interest (EOI) for DST SEED Project No: SEED/WS/2023/643

For Industrial Assistance in the Preparation of a Prototype Model for a Multifunctional Agricultural Robot

Issued by: JSS Academy of Technical Education Noida (JSS University Noida)

Date: 5-12-2024

Introduction

JSS Academy of Technical Education Noida (JSS University Noida) invites Expressions of Interest (EOI) from qualified and experienced industries, or engineering firms for **industrial assistance in the preparation of a prototype multifunctional agricultural robot**. The proposed robot will cater to diverse farming operations, including **seeding, disease detection, plant monitoring, spraying, harvesting, weed removal and plant management**.

The objective is to leverage advanced robotic technology to increase productivity, efficiency, and sustainability in the cultivation of crops such as **garlic, carrot, fennel, and turmeric**.

Scope of Work

The selected partner will assist in the development of a prototype model for the multifunctional robot, focusing on the following:

1. Design and Development of Various Robotic Functions

- **Weeding Tools:** Mechanisms for automated weed removal.
- **Seeding Mechanism:** Precision planting systems suitable for garlic, carrot, fennel, and turmeric crops.
- **Disease Detection Systems:** Integration of AI-enabled sensors and cameras to detect plant diseases in real-time.
- **Plant Monitoring:** Tools to gather data on crop growth, soil health, and environmental factors.
- **Spraying Mechanism:** Development of targeted organic fertilizer/ pesticide spraying systems.
- **Harvesting Tools:** End-effectors designed for efficient crop harvesting.

2. Development of Robotic Vehicle

- Design and fabricate a **mobile robotic platform** capable of navigating diverse field conditions.
- Ensure adaptability for specific tasks related to garlic, carrot, fennel, and turmeric cultivation.
- Integrate autonomous and semi-autonomous capabilities for field operations.

3. Prototype Testing and Optimization

- Conduct field trials to evaluate performance under real-world conditions.
- Optimize the prototype based on test results to ensure reliability and efficiency.

Eligibility Criteria

Interested industries must demonstrate:

- Proven expertise in **robotics, automation, or agricultural engineering**.
- Experience in developing robotic systems for **farming applications**.
- Availability of technical resources, including design and fabrication capabilities.
- Ability to collaborate effectively with researchers and agricultural experts.

Submission Requirements

Interested parties are requested to submit their EOI, including:

1. **Cover Letter**
 - Brief introduction of the organization.
2. **Technical Capability Statement**
 - Relevant experience, past projects, and technical expertise in similar fields.
3. **Team Composition**
 - Details of the proposed team, including qualifications and roles.
4. **Timeline and Milestones**
 - Tentative schedule for prototype development and testing phases.
5. **Cost Estimate**
 - Preliminary budget estimate for the scope of work.

Evaluation and Selection

Submissions will be evaluated based on:

- Technical feasibility of the proposed approach.
- Demonstrated expertise and track record.
- Cost-effectiveness and alignment with project objectives.
- Innovation and adaptability of the proposed solutions.

Submission Deadline

All EOIs must be submitted via email on or before 8-12-2024 by 5:00 PM.

Contact Details:



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