

Automated and Manual Watering System for Substation Earthing Using Sensors for Electric Safety

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Peer Review Information	Abstract
Type: Article Received: 30 March 2026 Revised: 25 April 2026 Accepted: 03 June 2026 Published: 22 June 2026	This project represents the automated and manual watering system for substation earthing using sensors for electric safety. This project describes about the safety precautions for earthing. This project consists of various types of sensors used in the project that is rain sensor, float sensor, moisture or capacitive sensor. The ESP 32 Microprocessor used in this project consists of high-resolution system that has large capacity code storage. It has wifi connectivity system. This makes it more reliable than ATmega 32 microcontroller. This microcontroller consists of IOT (internet of things) that is more reliable. Project has seven segment display to improve manual control for watering. The earthing is the most important factor in the electrical system. In this project main focus is earthing in a 33/11 kV substation. ESP 32 Microprocessor consists of power supply that is SMPS switch mode power supply. The project consists four earth pits used for earthing. The main purpose of our project is to maintain the earth resistance. The earthing resistance must be less than 5 ohms. So, in this project we maintain the earthing resistance via soil moisture sensor and also float sensor. Keywords: ESP32 Microprocessor; Substation Earthing; Earth Pits; Sensors; Ground Resistance Monitoring; Electrical Safety; Smart Monitoring System; Power Distribution Network.

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Introduction

The earthing is the most important factor in the electric system. Earthing reduces the leakage current in the electric equipment. The value is always less than 5 ohms. When the earthing resistance is high then the leakage current will be increased. Earthing consists moisture, that is resistance is in proper value.

The project consists the various types sensors for example. Float sensor, moisture sensor, capacitive sensor. The main component in the project is ESP 32 microcontroller. ESP 32 has high Resolution signal. It converts analog signal to digital signal at very high resolution. So, it converts through sensors. ESP 32 has most efficient feature, that is touch screen, WIFI based, Wireless Communication. The ESP 32 is very energy efficient in operating system. Also it has fast resolution system that is Analog to digital signal conversion.

The project is replacing manual function into automatic function. In this project automatic water is used in the earth pits for maintaining the resistance. Thus, the ESP 32 sense the signal from the earth pits and the water is fed to the earth pits. There is proper System operation and control strategy for ESP 32.

Sensor used in the project

- ESP 32 Microcontroller: ESP 32 has high Resolution signal. It converts analog signal to digital signal at very high resolution. So, it converts through sensors. ESP 32 has most efficient feature that is touch screen, WIFI based, Wireless Communication. It is energy efficient in operating system. Also it has fast resolution system that is analog to digital signal conversion.
- Soil Moisture Sensor (Capacitive Sensor): A soil moisture sensor (capacitive sensor) measures the moisture of earthing pits of the substation. It helps to reduce the manual operation. Due to this it is energy efficient. It also prevents the dry run that is when motor runs at dry mode then the ESP 32 Microcontroller senses the dry mode and the motor will stop.
- Float sensor or float switch: A float switch has two operating modes that is full operating mode and less operating mode. It is connected to the soil moisture sensor.
- Water sensor or rain sensor: Rain sensor is used for stop excess of water.
- Relay unit: Relay unit is used for protection of other equipment. It reduces the over-current and trip the circuit.
- Water pump: Water pump is used for supply the water to the earthing pits.
- Power supply: 12-volt AC transformer is used for supply the project. The output is 12-volt DC feed to the circuit. The ESP 32 has large storage capacity of codes and signals. Also, it has high resolution system (analog to digital Conversion system). It improves system efficiency. ESP 32 has most efficient feature that is touch screen, WIFI based, Wireless Communication, energy efficient in operating system. Also, it has fast resolution system that is analog to digital signal conversion.

Control circuit

The control consists of sensor unit and power supply unit and also, relay unit. The control unit has ESP 32 microcontroller. It has most efficient feature that is touch screen, WIFI based, wireless communication, Energy Efficient in operating system. Also it has fast resolution system that is analog to digital signal conversion.

Advantages of ESP 32

- Memory capacity: The ESP 32 has larger storage capacity of codes and signals. Also it has high resolution system (analog to digital Conversion system). It improves system efficiency.
- Advanced feature of ESP 32: ESP 32 has most efficient feature that is touch screen, WIFI based, Wireless Communication, Energy Efficient in operating system. Also it has fast resolution system that is Analog to digital signal conversion.
- Fast Response due to ESP32 : ESP 32 has high Resolution signal. It is convert analog signal to digital signal at very high resolution. So, it converts through sensors.
- Energy Efficient operation: The ESP 32 represents many energy saving operations by using battery. That is ESP 32 detects the requirement of the system.
- Safety and automatic operation: In this project the ESP 32 are used for wireless communication. Due to ESP 32 it has two modes that is manual and also wireless Communication or IOT (internet of things) due to this it reduces the manual operation. So, it improves the system efficiency and flexibility.

The primary object of the project is the earthing. The earthing is the most important factor in the electric system. Earthing reduces the leakage current in the electric equipment. The value is always less than 5 ohms. When the earthing resistance is high then the leakage current will be increased. Earthing consists moisture that is resistance is in proper value.

- Sensing unit: The sensing unit consists the various types of sensors for example. Float sensor, moisture sensor and capacitive sensors.

- Manual function and automatic function: It has also manual function to improve system stability.
- Cost effective: The project is cost effective due to use of ESP 32 Microcontroller. It replacing the manual function into automatic function.
- Safety of the system: Safety is present due to sensors and ESP 32 microcontroller. The earthing is most important factor in the electric system. Also, this project is based on ESP 32 when the resistance is increased then the leakage current will produced in the electric equipment so, hence moisture is very important for the resistance.
- Stability and reliability: Stability and reliability is present due to sensors and microcontroller. It maintains stability and accuracy.

Hardware Components

1. ESP 32 Microcontroller: ESP 32 has high Resolution signal. It is converting analog signal to digital signal at very high resolution. So, it converts through sensors. ESP 32 has most efficient feature that is touch screen, WIFI based, Wireless Communication, Energy Efficient in operating system. Also it has fast resolution system that is Analog to digital signal conversion.
2. Soil Moisture Sensor (Capacitive Sensor): A soil moisture sensor (capacitive sensor) measures the moisture of earthing pits of the substation. It helps to reduce the manual operation. Due to this it is energy efficient. It also prevents the dry run that is when motor runs at dry mode then the ESP 32 Microcontroller senses the dry mode and the motor will stop.
3. Float sensor or float switch: A float switch has two operating modes that is full operating mode and less operating mode. It is connected to the soil moisture sensor.
4. Water sensor or rain sensor: Rain sensor is used for stop excess of water.
5. Relay unit: Relay unit is used for protection of other equipment. It reduces the over-current and trip the circuit.
6. Water pump: Water pump is used for supply the water to the earthing pits.
7. Power supply: 12 Volt AC, 5 amp transformer is used for supply the project. The output is 12 volt, 5 Amp DC feed to the circuit.

Software Details

(step by step)

soil moisture analog to digital

float switch

rain sensor

check mode switch (manual or auto)

If auto mode:

If the soil dry AND tank full AND no rain

Start pump timer

Stop pump

If manual mode:

If manual button is pressed or through software

Start pump

Supplementary Material

- Safety and reliability of the project: The automatic watering system reduces the risk condition like dry earthing and dry run. The system reduces to risk condition due to automatic watering system. So, it reduces the risk condition and electric shock condition.
- Efficiency of the project: The rain sensor, capacitive sensor and also moisture sensor helps to improve system efficiency due to sensors robustness. These sensors work in every condition i.e. summer, winter and rainy season.
- Technical Advantages: The ESP 32 helps to improve system reliability and also system efficiency so, this operation is also known as RTO (Real Time Operation). So, RTO helps to live monitoring system of Earth pits. It protects from leakage current.

Result and Performance

The demonstration of the ESP 32 micro-controller consists of real time operation and also this project is condition based that is it is very reliable. It helps improve system efficiency due to various types of sensors used in the project for example: - Moisture sensor, capacitive sensor and also, dry run sensor. This project reduces the leakage current of earthing (*it reduces the earthing resistance*).

- Safety precaution in the project: This project represents the safety precautions of leakage current. The leakage current occur due to poor earthing or due to less water provide to the earthing. When the earthing resistance is high i.e it has more leakage current

and this leakage current is going in the electric equipment. So, our project is sensors based so, maintains the resistance of earthing pits. Therefore, reduce the leakage current.

- **Data Accuracy:** The data accuracy is very important in every system. In this project it is sensor based so, it has most accurate data due to sensors. It improves system efficiency and system reliability. There are various types sensors are used in the project like float sensor, capacitive sensors and capacitive sensors.
- **Operational System:** The operational system of the project is reliable due to sensors and automated system. So, it reduces the manual operation.

This project represents the automatic watering system to the substation. This project helps to improve system reliability and efficiency of the substation. In this project the main components are capacitive sensor, moisture sensor, dry run sensor. This Dry run sensors are used for motor protection i.e. when the motor runs at dry condition the dry sensor will sense the dry condition and it will be automatically OFF. This project reduces the leakage current and also short circuit current. This project is RTO based i.e. Real Time Operation system, that is it shows the real time moisture of the earth pits of the substation. So, this project is reliable, cost efficient and also reduces the leakage current.

- **Safety and reliability of the project:** The automatic watering system reduces the risk condition like dry earthing and dry run, The system reduces to risk condition due to automatic watering system. So, it reduces the risk condition and electric shock condition.
- **Efficiency of the project:** The rain sensor, capacitive sensor and also moisture sensor help to improve system efficiency due to sensors robustness. These sensors work in every condition i.e. summer, winter and rainy season.
- **Technical Advantages:** The ESP 32 helps to improve system reliability and also system efficiency, so, this operation is also known as RTO (Real Time Operation). So, RTO helps to live monitoring system of Earth pits. It protects from leakage current.

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