Department of Electronics & Communication Engineering

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Bachelor of Engineering *in*

Electronics and Communication Engineering

Minor Project Report

Project Title: *Determining types of underground soil for tunnel drilling*

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ABSTRACT:

- The project aims to develop a methodology for classifying and analyzing different types of soil encountered during tunnel drilling operations.
- Understanding soil composition and characteristics is crucial for successful tunnel planning, design, and construction.
- Field surveys and soil sampling techniques are employed to collect soil samples from various tunnel sites with different soil conditions.
- The project's results will contribute to the development of a tailored soil classification system for tunnel drilling, assisting engineers in decision-making and risk mitigation.
- The proposed methodology aims to enhance the efficiency and safety of tunnel construction projects by providing valuable information for planning and execution.

INTRODUCTION:

The project titled "Determining Types of Underground Soil for Tunnel Drilling" aims to address the critical need for a comprehensive methodology to classify and analyze the different types of soil encountered during tunnel drilling operations. Understanding the composition and characteristics of underground soil is of paramount importance in ensuring the successful planning, design, and construction of tunnels. By providing a systematic approach to identify and categorize various soil types, this project aims to empower engineers and construction teams to make informed decisions and implement appropriate drilling techniques.

To achieve this objective, the project begins by conducting a thorough review of existing literature and studies related to soil classification and tunneling. This literature review serves as the foundation for understanding the various geological factors and parameters that influence soil behavior and their implications for tunnel excavation.

The results of this research project hold significant promise for the development of a comprehensive soil classification system tailored specifically for tunnel drilling operations. Such a system would assist engineers and geotechnical experts in selecting appropriate drilling methods, designing effective support systems, and mitigating potential risks associated with specific soil types.

Types of soils:

Sand: Sand is often encountered in underground tunnel digging when the excavation reaches areas such as riverbeds, coastal regions, or areas with sandy deposits. Sand can be found in layers or pockets depending on the geological conditions.

Silt: Silt is typically encountered in underground tunnel digging when excavating in areas with low-energy water environments, such as riverbanks, floodplains, or estuaries. These areas tend to have fine sediment deposits, including silt.

Gravel: Gravel is commonly encountered during underground tunnel digging when excavating in areas with riverbeds, alluvial deposits, or areas where glacial deposits have occurred. These regions often have coarse sediment composed of gravel.

Clay: Clay is frequently encountered in underground tunnel digging, especially in areas with clay-rich soil deposits. Clay can be found in various geological formations such as marine sediments, lakebeds, or areas with high clay content in the soil profile.

Rock: Rock formations are encountered in underground tunnel digging when the excavation reaches solid bedrock. The presence of rock can vary depending on the geological conditions of the project site. It can range from shallow rock layers near the surface to deep rock formations that require significant drilling or blasting for excavation.

Differentiation between the sand, slit and gravel with the help of values of Electrical conductivity

1. Sand:- Sand typically has relatively low electrical conductivity.

   EC (10-20 μS/cm)

2. Slit:- Silt generally exhibits higher electrical conductivity compared to sand

   EC (20-35 μS/cm)

3. Gravel:- Gravel typically has low electrical conductivity similar to sand.

   EC (30-50 μS/cm)

COMPONENTS USED:

- Soil EC sensor
- Moisture sensor
- Servo motor
- MODBUS MAX 485
- Arduino UNO
- Arduino NANO

METHODOLOGY AND EXPERIMENTAL DESIGN:

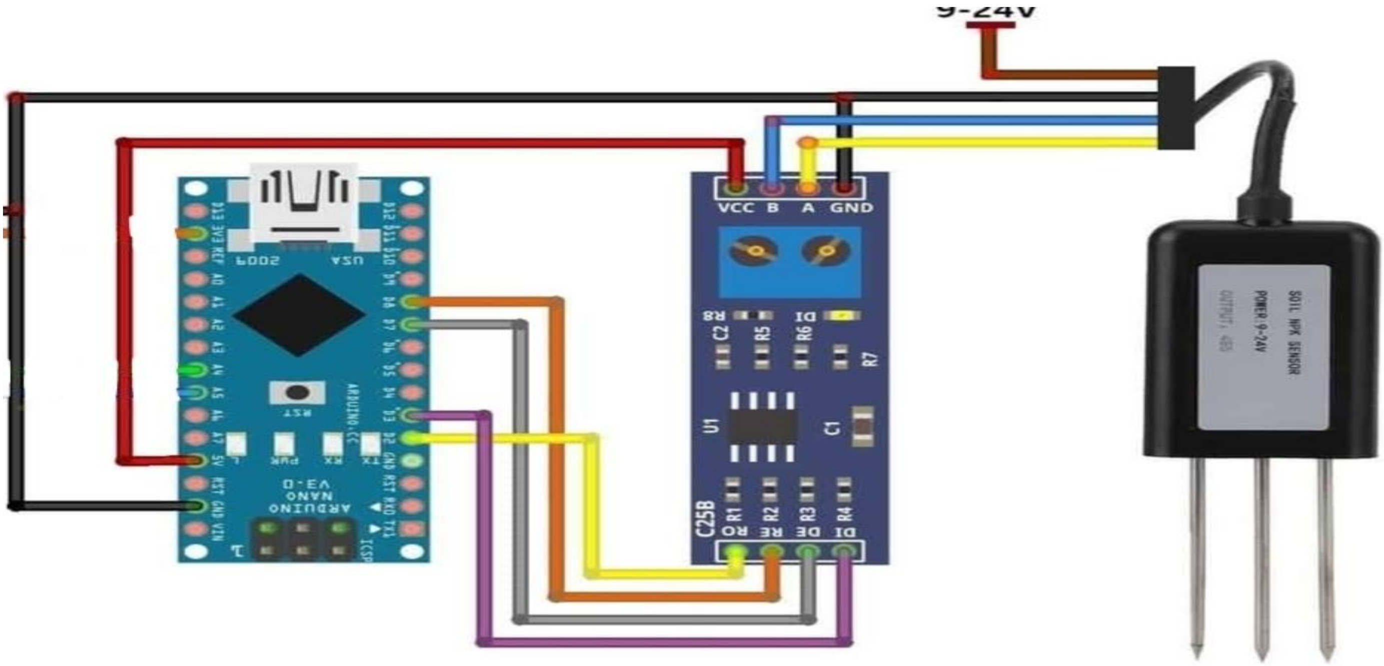
At first, the servo motor will rotate and make a moisture sensor go inside the soil, the moisture sensor senses the percentage of moisture in the soil and from that value soil can be segregated into clay rock and a combination of soil, slit, gravel as per the percentage of moisture in the soil.

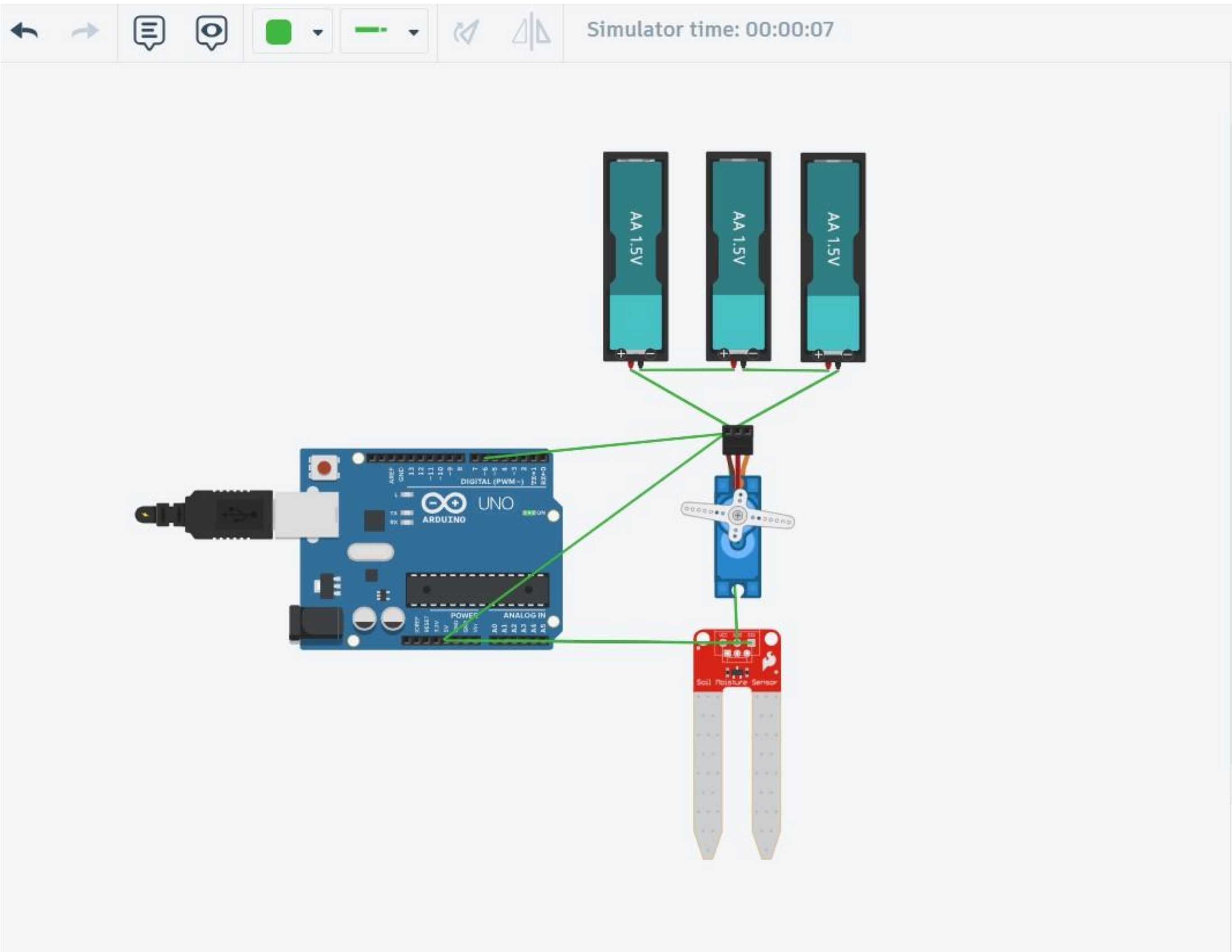
If the moisture percentage lies in the combination soil, slit, gravel then, the EC sensor senses the value of the conductivity of the soil then form the value soil will be segregated into sand, slit, gravel and then that value will be taken and used to deliver the power to the shaft for rotation accordingly. If the soil conductivity is more then soil particles are more and it requires more amount of power to drill the tunnel and if soil conductivity is less then less power is required to drill the tunnel.

DESIGN PROCEDURE:

- The servo motor and sensors are connected to the pins of Arduino UNO.
- Then controller is connected to system to provide the power and dump the code into the controller.
- The values received from the Moisture sensor will give output in the form of percentage values .
- The values received from the EC sensor will give output in the units of us/cm.
- The data received from the sensors will be processed in controller then the output will be displayed in sytem(Monitor).

CIRCUIT DIAGRAM:





FUTURE SCOPE:

- This can be interfaced with a automated tunnel digging robot which can segregate or differentiate the type of soil in front of it without any human intervention. And the robot automatically adjust the shaft rotation according to the type of soil to dig the tunnel. Hence, reduced in power consumption of robot and reduces human efforts

CONCLUSION:

In conclusion, the project successfully developed a systematic methodology for classifying soil encountered during tunnel drilling, emphasizing the importance of understanding soil composition and characteristics. Field survey is utilized to gather data and establish a comprehensive soil classification system. The project's findings will assist engineers in making informed decisions, enhancing the efficiency and safety of tunnel construction projects.

REFERENCE:

1. Soil classification for tunnels and underground structures: A critical review and proposed classification system Authors: Yu Heng Cheng, Jie Han

Journal: Tunnelling and Underground Space Technology

2. Advances in soil identification and classification using sensor technologies Authors: Khandaker M. Anwar Hossain, Mayank Tyagi, and Jamal Uddin.

Journal: Journal of Terramechanics

3.Piezoelectric sensors for measuring tunnel face stability during excavation in soft ground" by S. Esmaeilzadeh and M. Ghalehnovi. This paper discusses the use of piezoelectric sensors to measure tunnel face stability during excavation in soft ground. The authors conducted laboratory experiments and field tests to evaluate the effectiveness of the sensors in determining the stability of the tunnel face and the type of soil encountered.

4.The Geonics Technical Note TN5, "Electrical Conductivity of Soils and Rocks.