

Real time Knowledge of ore body being mined out

Title: Geospatial Joins and Interpolation for real time guiding using GPS location and elevation levels

PPT by BYTE BENDERS

INTRODUCTION

Our solution makes use of wireless communication systems employing IoT devices along with a spatial interpolation method interfaced with a responsive dashboard. Firstly, GPS location sensor and the pressure value sensors detect the readings which is displayed on the dashboard and sent to the control unit.

The operator can have a look at the suggestion provided by the interpolation algorithm, working based on GPS location and elevation values and then move accordingly to obtain better quality ores. The communication between the control unit and the dashboard is achieved via two-way communication using Xbee modules.

The sensor's' input directs the microcontroller module, which transmits it to the control unit. The control unit then performs the necessary calculations and then transmits them back to the operator. The model efficiently manages mining operation, optimizing practices for optimal yield.

Technology Stack:

1. Arduino Nano: It is Arduino's classic breadboard friendly designed board with the smallest dimensions. Microcontroller is ATmega328 having a Flash Memory of 32 KB of which 2 KB used by bootloader. Digital I/O Pins are 22 (6 of which are PWM). The ATmega328 has 2 KB of SRAM and 1 KB of EEPROM. The Nano has 8 analog inputs, each of which provide 10 bits of resolution (i.e. 1024 different values).

2. XBee Module: XBee modules operate within ISM 2.4 GHz (Unlicensed) frequency band. XBee modules support ZigBee protocol which is based on IEEE 802.15.4 standard. XBee modules uses DSSS (Direct Sequence Spread Spectrum) modulation technique for communication. It has serial UART pins for communication with PC and Microcontrollers serially.

3. Neo-6M GPS Module: This module has an external antenna and built-in EEPROM, with an interface of RS232 TTL. It can work with a power supply of 3V to 5V at a default baudrate of 9600 bps. It works with standard NMEA sentences and is also compatible with other microcontroller boards.

4. BMP180 Barometric Pressure Sensor: BMP180 is one of sensor of BMP XXX series. They are all designed to measure Barometric Pressure or Atmospheric pressure. BMP180 is a high precision sensor designed for consumer applications. Barometric Pressure is nothing, but weight of air applied on everything. The air has weight and wherever there is air its pressure is felt. BMP180 sensor senses that pressure and provides that information in digital output.

5. Uni4 XBee/ZigBee Adapter Board: Plug the unit into the XBee Explorer, attach USB cable, and we will have direct access to the serial and programming pins on the XBee unit. The board is powered by the USB cable. Enables efficient communication and power distribution among various components.

Libraries for the Dashboard:

- Streamlit: Used for creating interactive web applications for the dashboard.
- Pandas: Facilitates data manipulation and analysis for the dashboard.
- PIL (Pillow): Utilized for image processing tasks within the dashboard.

ALGORITHMS:

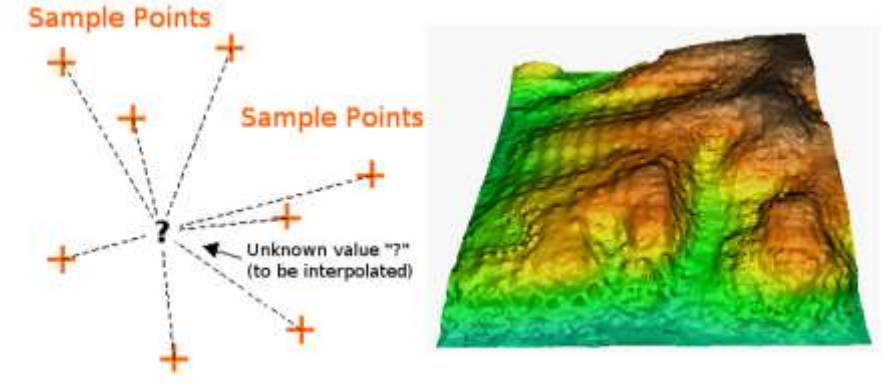
1. Elevation Calculation: The pressure reading noted by the BMP180 sensor is fed to the control unit where it is used to calculate the elevation level as per the formula given below:

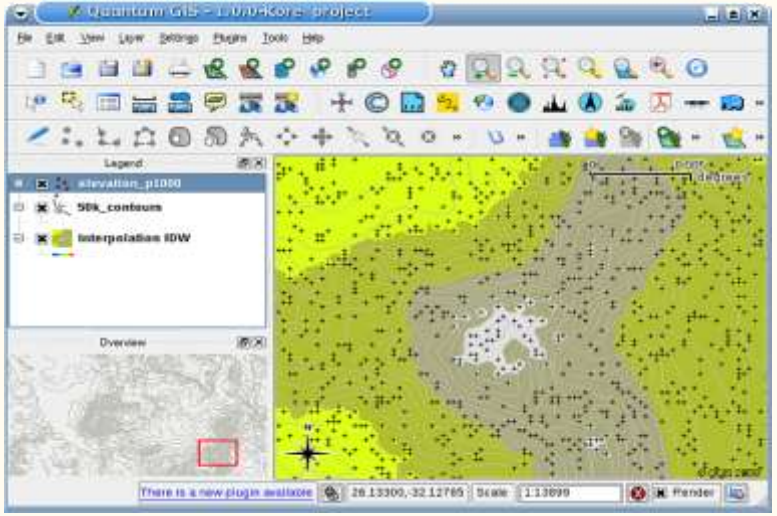
$$altitude = 44330 \times \left(1 - \left(\frac{P}{P_0}\right)^{\frac{1}{5.255}}\right)$$

P : *Atmospheric pressure at current location (in hPa)*
P_0 : *Atmospheric pressure at sea level (in hPa)*

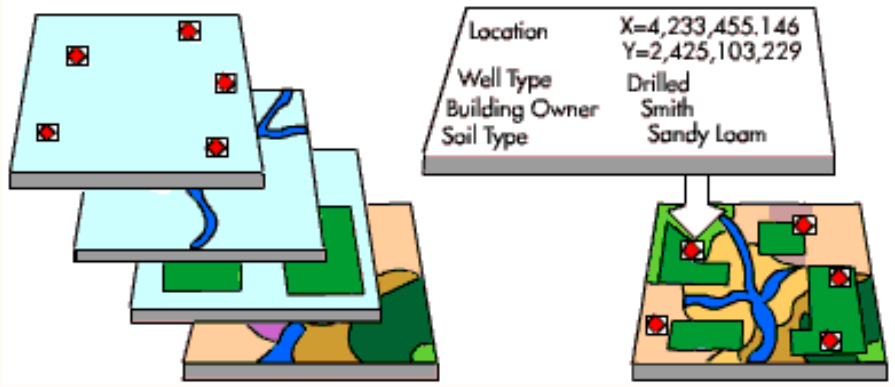
This elevation calculated in the initial stage is the fed to the interpolation and the spatial join stages which is used to pinpoint the location of the miner with respect to the planned orebody model to enhance efficiency of the mining process.

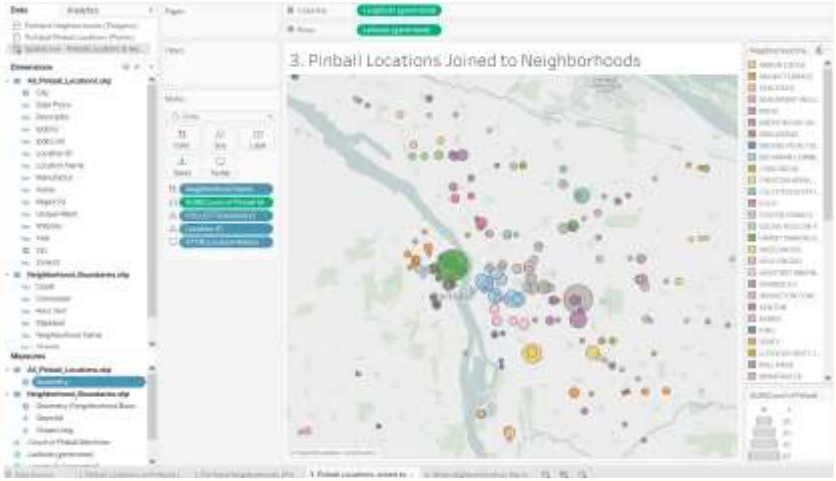
2. Spatial Interpolation: Spatial analysis is the process of manipulating spatial information to extract new information and meaning from the original data. Spatial interpolation is the process of using points with known values to estimate values at other unknown points. We will use this methodology using the **inverse weighted distance** to find out any unmapped ore quality region to enhance the quality of the ore-body model



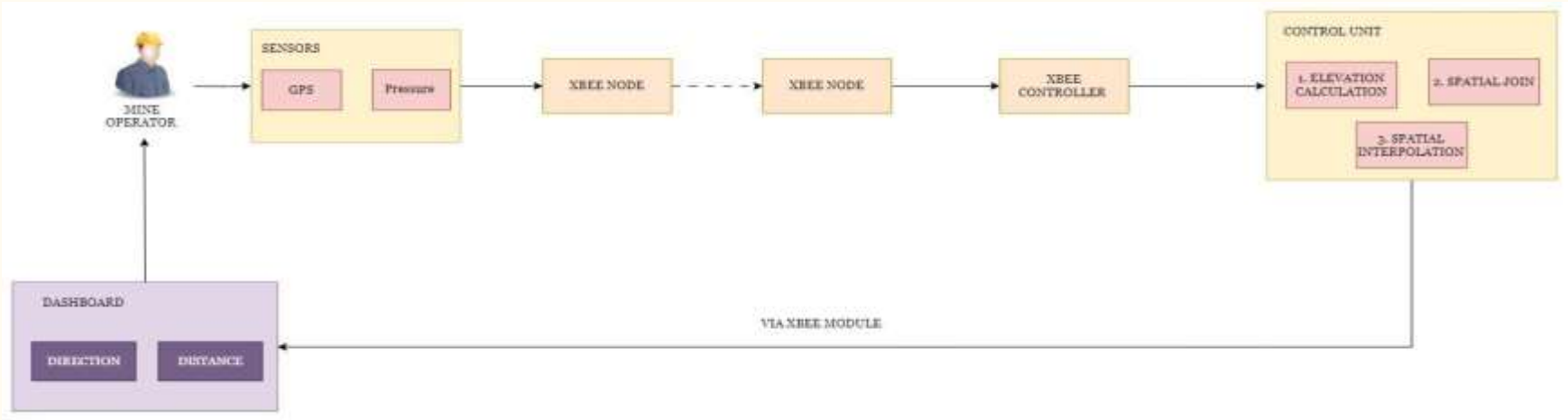


3. Spatial Join: A spatial join **matches rows** from the Join Features values to the Target Features values **based on their relative spatial locations**. To extrapolate this feature in our model, we take in the GPS location and the elevation values to construct a **reference plane feature** as the output. This reference plane is compared with the ore-body model prepared beforehand to obtain the direction and distance which is conveyed to the operator.





FLOWCHART


MINE OPERATOR
SENSORS
GPS
Pressure
XBEE NODE
XBEE NODE
XBEE CONTROLLER
CONTROL UNIT
1. ELEVATION CALCULATION
2. SPATIAL JOIN
3. SPATIAL INTERPOLATION
DASHBOARD
DIRECTION
DISTANCE
VIA XBEE MODULE

CIRCUIT DIAGRAM