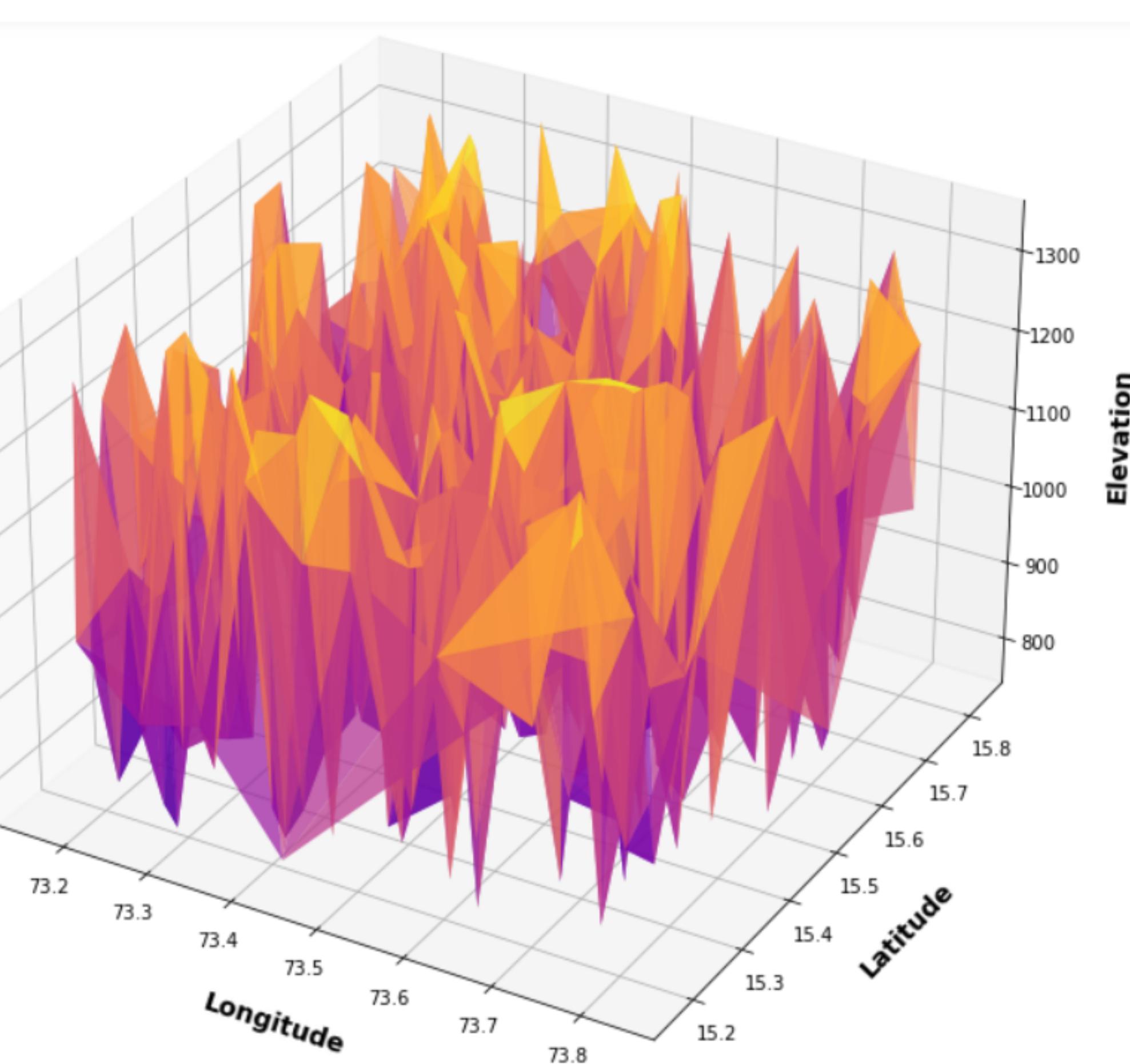
A large yellow dump truck is shown from a side-on perspective, driving along a grey asphalt road that cuts through a massive open-pit copper mine. The mine walls are steep and layered with various shades of brown, orange, and grey rock. The truck is carrying a load of reddish-brown ore. The sky is clear and blue.

**REAL TIME KNOWLEDGE OF
ORE BEING MINED OUT**

TEAM BYTEBENDERS

ORE BLOCK MODEL



The **Python code** visualizes a continuous, graded ore model in a **3D plot**, incorporating **spatial interpolation** for ore concentration across **latitude, longitude, and elevation**. It utilizes **Seaborn**, **Matplotlib**, and triangulated surfaces to provide a comprehensive view of ore distribution, with contour plots for detailed cross-section insights.

INTERPOLATED DATABASE

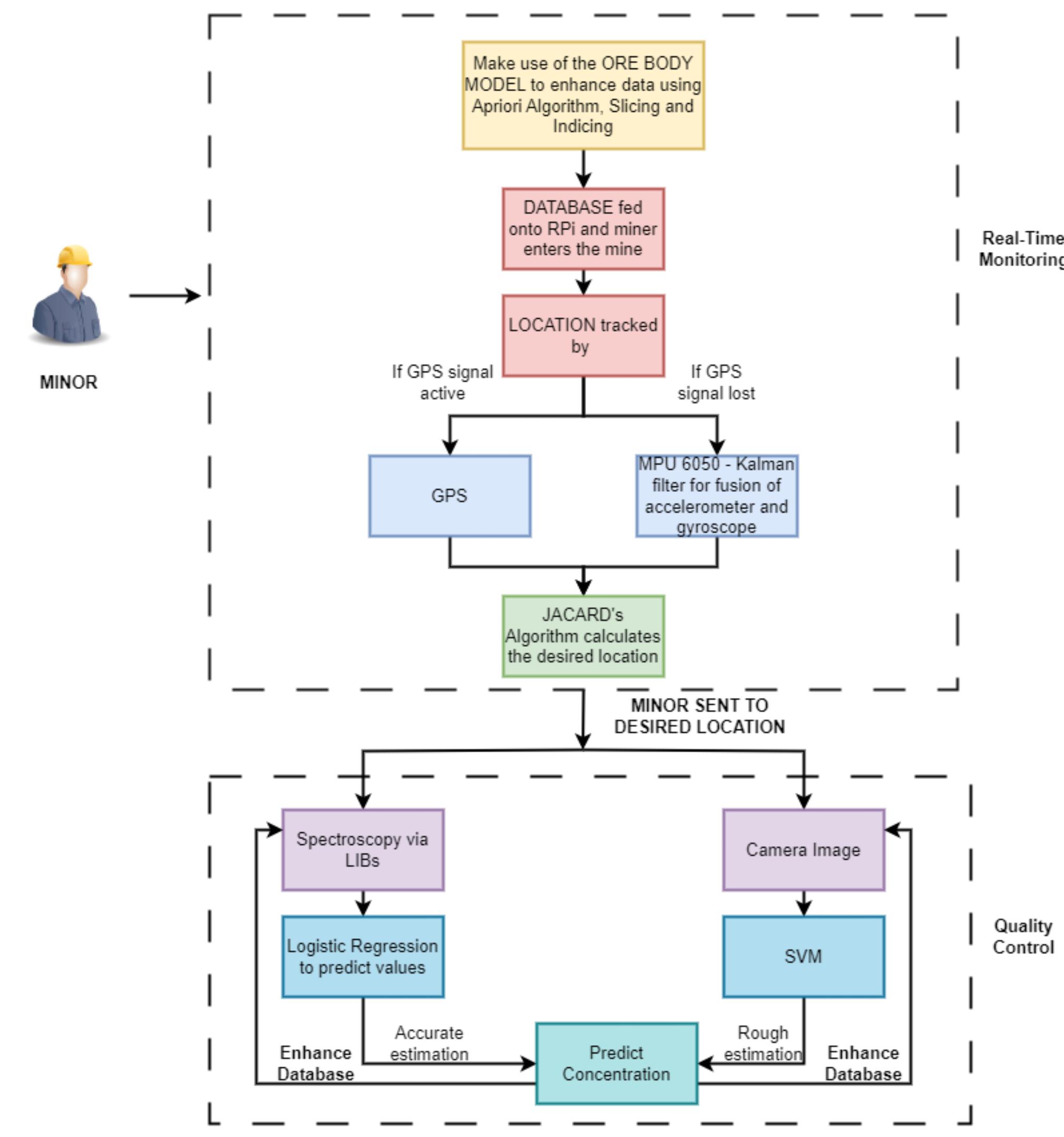
Latitude	Longitude	Elevation	Temperature	Depth	Ore Concentration in %
15.41636008	73.63210781	861.0797573	33.57245355	20.03846145	72.30812443
15.8004762	73.52406424	1075.140568	32.37545633	19.36102476	70.22941722
15.65466263	73.37301841	1273.767502	18.76926197	49.6877107	63.9264554
15.56577232	73.70919668	1189.334932	28.23743483	19.47912519	76.54955574
15.27067909	73.62315412	1233.936689	29.40586856	20.5096874	51.61565901

....500 rows

METHODOLOGY

1. We have adopted a **distributed system via local host** to overcome the challenges posed by the wireless communication
2. We have pre-processed the data using **Slicing/indexing** and employing the **Apriori algorithm** to reduce the computational size and latency.
3. **Gyro** has been used to continue tracking the miner integrated with the accelerometer in case the **GPS stop tracking** the location of the user when he enters regions lacking proper connectivity.
Kalman filter is used to provide a more accurate estimate of the current state based on noisy sensor measurements.
4. **LiDAR** has been mounted on a Servo Motor on the top of the vehicle for obstacle scanning.
5. **Ad Hoc Mesh networks** are formed spontaneously by mobile devices(nodes) and a router without a need for any pre-existing infrastructure. This would help in real-time monitoring and updation.

FLOWCHART

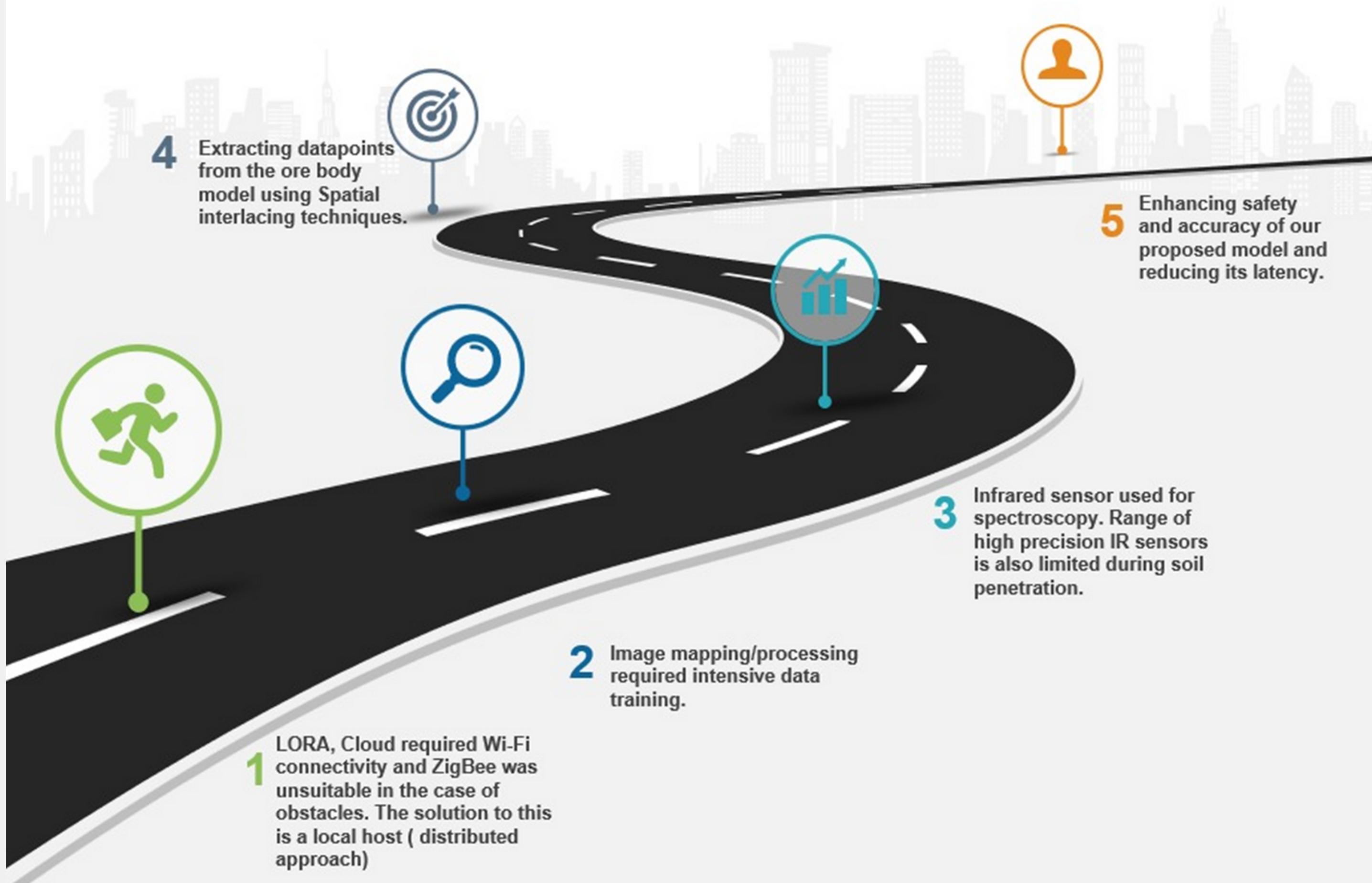


Technology Stack

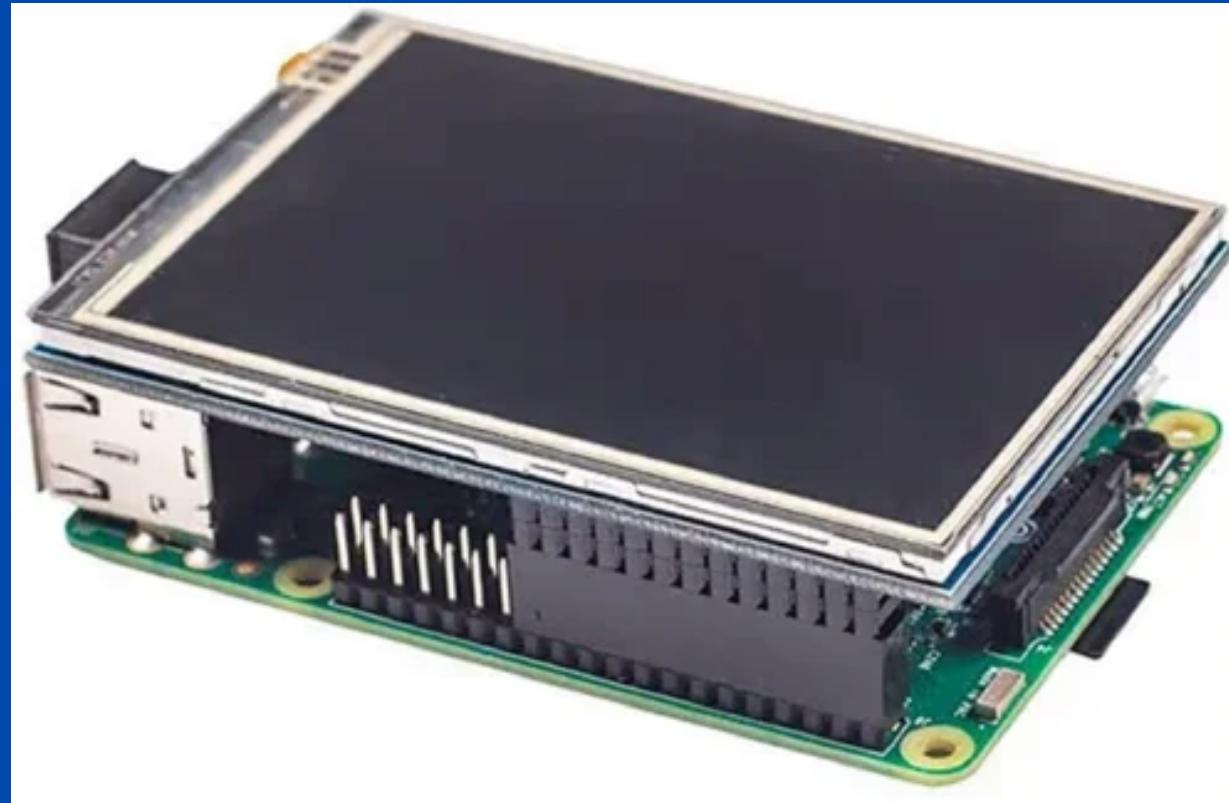
NEO 7M GPS GY-GPS6MV2 Module
BMP180 BAROMETRIC PRESSURE SENSOR
RASPBERRY PI Model B 8Gb
Raspberry Camera module
LiDAR TF MINI Laser range sensor
S-90 Servo Motor
SIM 800L GSM GPRS Module
MPU 6050
Ultrasonic Sensor
PCB BMP Sensor



Roadmap



SAFETY



- **Temperature and Pressure sensor** values can be used to send alert messages to the miner.
- Alert messages in case of loss of GPS signal can be sent via the **SIM800A GSM GPRS Module**.

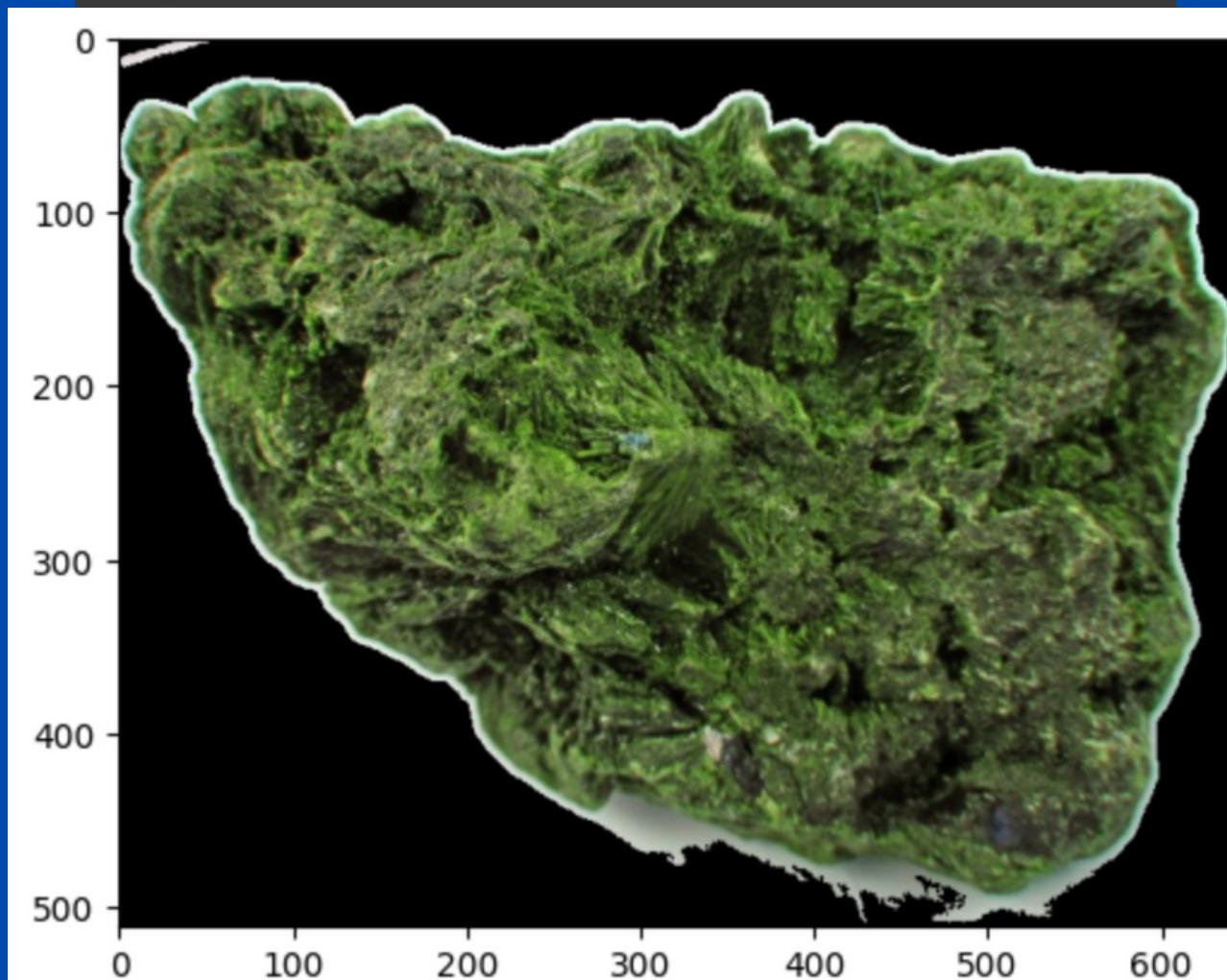
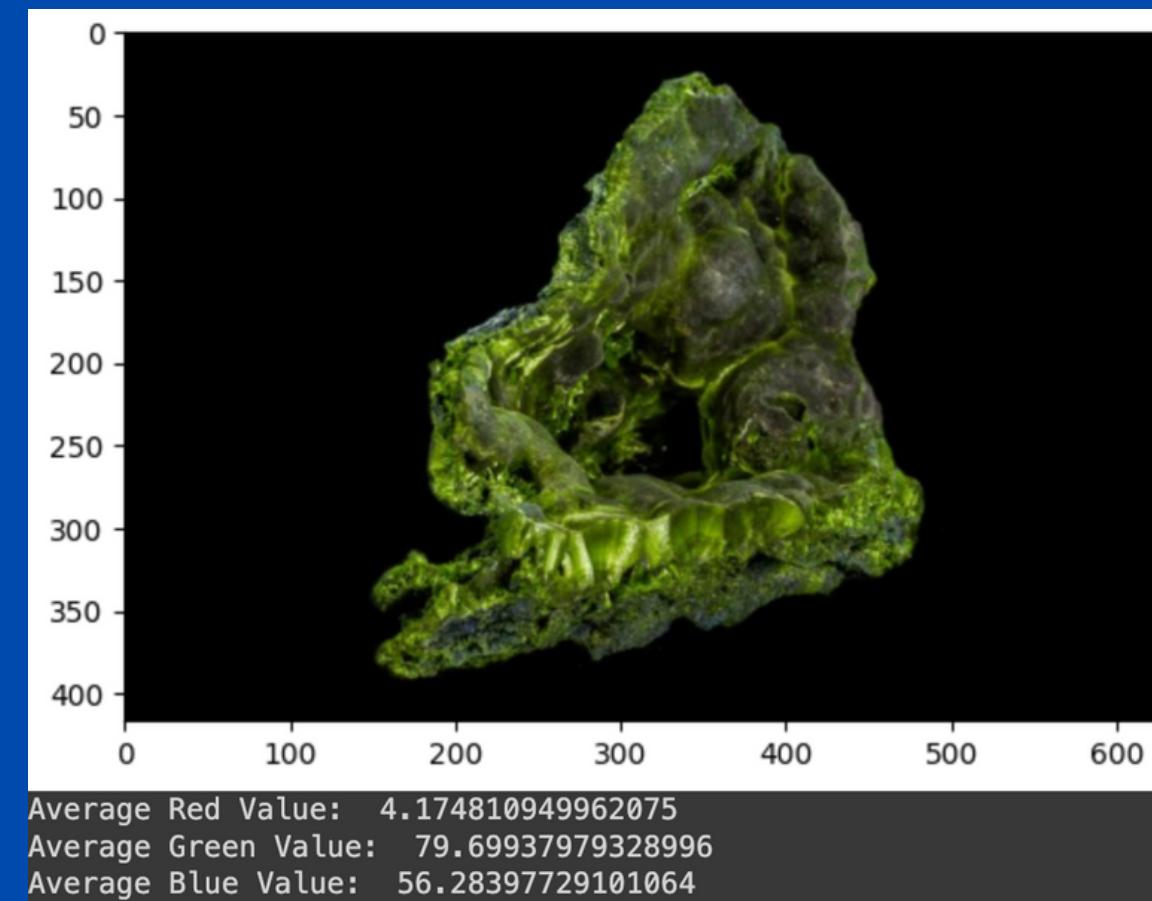
INDUSTRIAL STANDARDS FOR EQUIPMENTS USED DURING MINING:

- **IP 65, IP66** (Casing for PROTECTION AGAINST DUST, WATER).
- **Resistive display** to prevent damage due to debris, pressure and temperature conditions.

ML MODEL

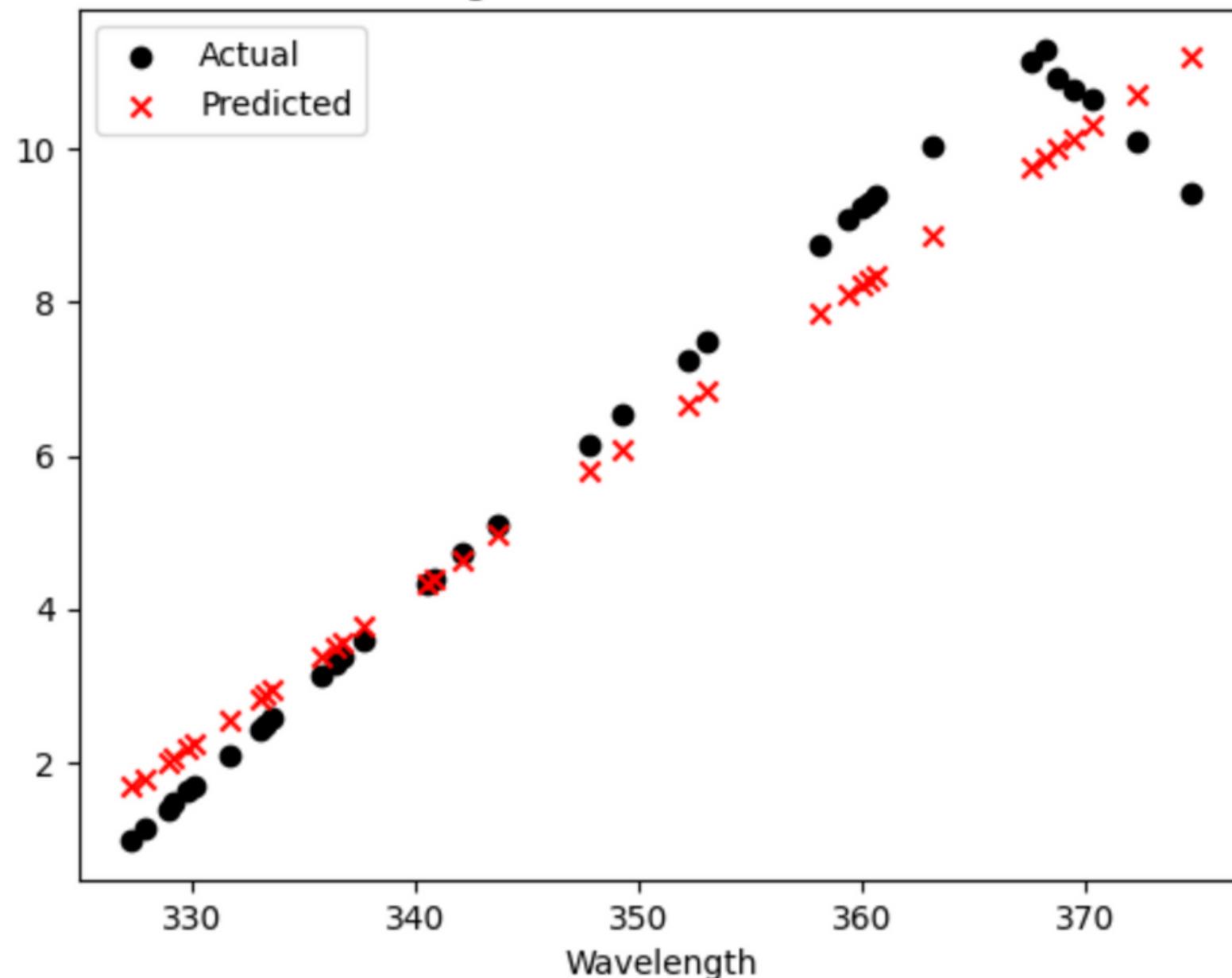
```
Red_Mean  Green_Mean  Blue_Mean  Concentration
0          8           78          81        41.401573
1         13           89          53        39.708937
2         11           58         134        49.827261
3         16          100          82        36.624476
4          9           78          121       20.301029
Mean Squared Error: 177.7037252437576
R-squared: 0.27196059758878777
Predicted Ore Concentration: 34.957683316872746
/usr/local/lib/python3.10/dist-packages/sklearn/base.py:439: UserWarning:
  warnings.warn(
```

```
Accuracy: 0.95
Confusion Matrix:
[[8 0 0]
 [0 7 0]
 [0 1 4]]
   Wavelength  Concentration  MineralType  PredictedMineralType
0    624.724071      3.142919    siderite        siderite
1    970.428584     63.641041  magnetite        magnetite
2    839.196365     31.435598  magnetite        magnetite
3    759.195091     50.857069    siderite        siderite
4    493.611184     90.756647  haematite        haematite
...
95   696.277358     34.920957    siderite        siderite
96   713.639698     72.595568    siderite        siderite
97   656.524611     89.711026    siderite        siderite
98   415.251476     88.708642  haematite        haematite
99   464.734856     77.987555  haematite        haematite
[100 rows x 4 columns]
```

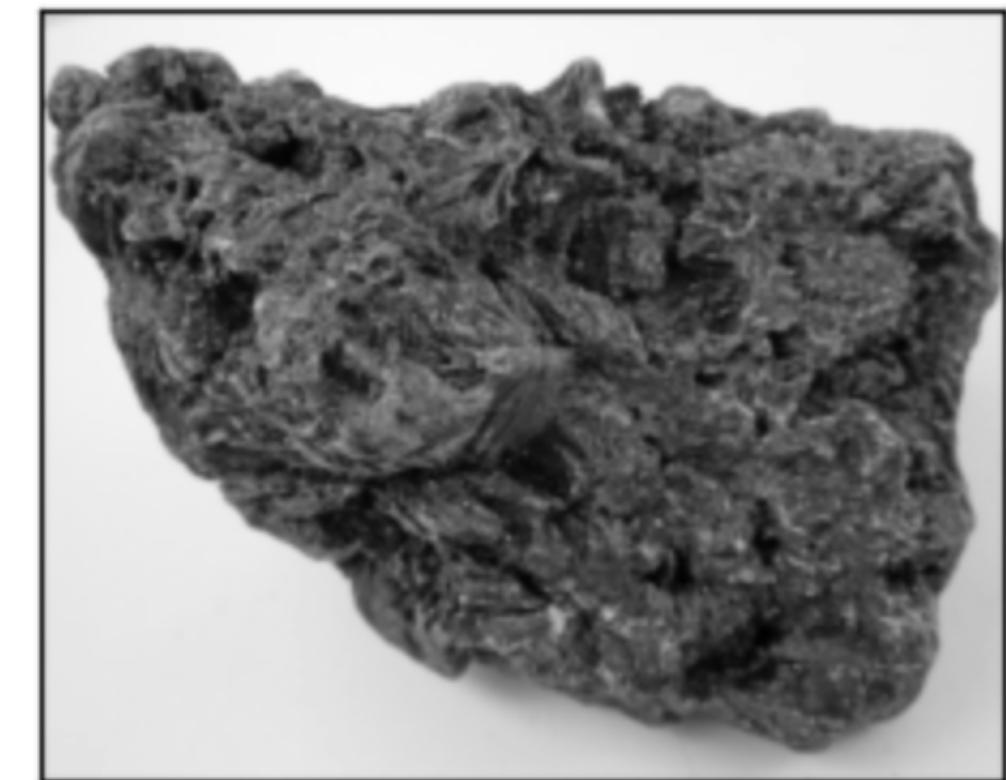


Mean Squared Error: 0.5478162972033622

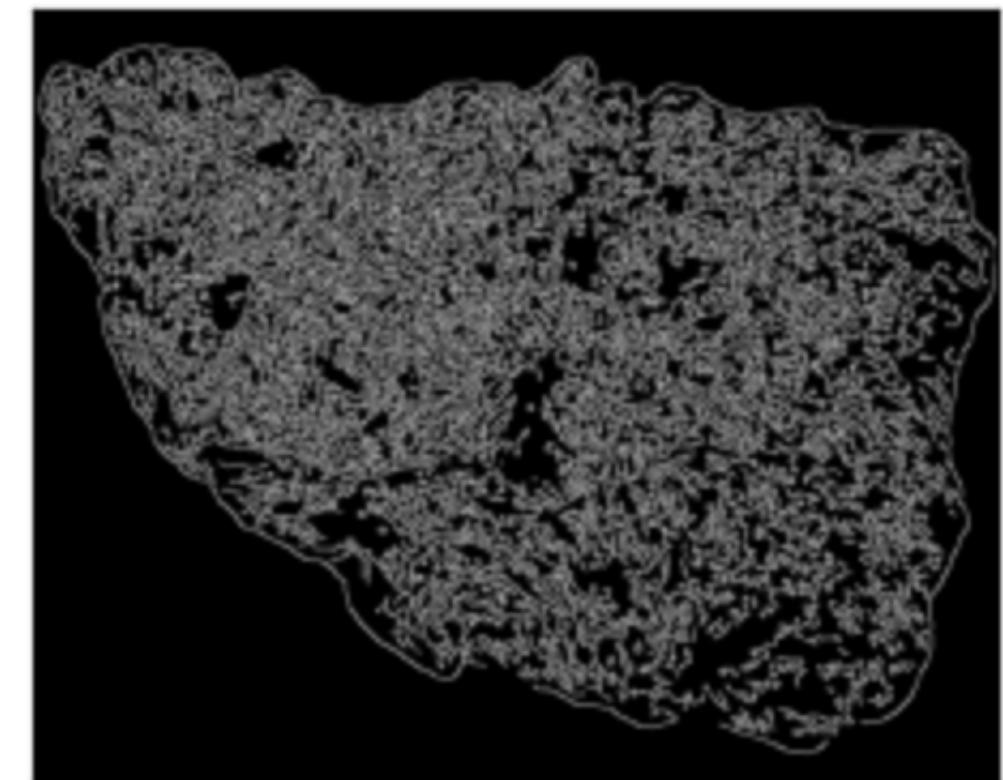
Linear Regression - Predicted vs Actual



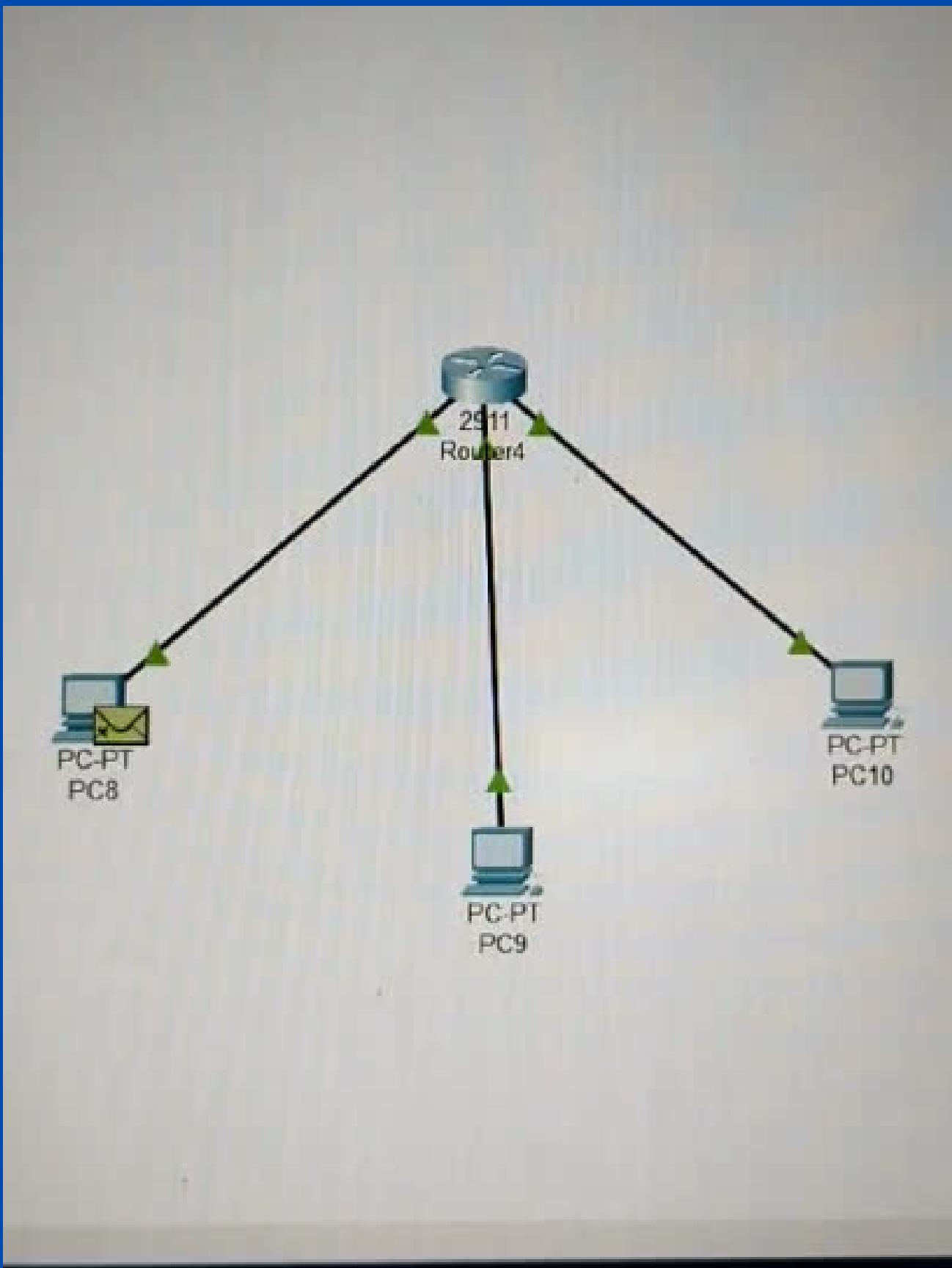
Original Image



Edge Image



ADHOC - MESH NETWORK



www.phpmyadmin.co /sql12.fri +

← → G phpmyadmin.co/sql.php?db=sql12672355&goto=db_structure.php&table=mine_data&pos=0

phpMyAdmin

Recent Favorites

Server: sql12.freesqldatabase.com » Database: sql12672355 » Table: mine_data

Browse Structure SQL Search Insert Export Import Operations

Showing rows 0 - 5 (6 total, Query took 0.1696 seconds.)

SELECT * FROM `mine_data`

Profiling [Edit inline] [Edit] [Explain]

Show all Number of rows: 25 Filter rows: Search this table Sort by key: None

+ Options

<input type="checkbox"/>				1 1 done 2023-12-22 11:47:05
<input type="checkbox"/>				2 4 in progress 2023-12-22 11:47:17
<input type="checkbox"/>				3 3 incomplete 2023-12-22 11:47:38
<input type="checkbox"/>				4 5 incomplete 2023-12-22 11:51:25
<input type="checkbox"/>				5 1 in progress 2023-12-22 12:12:33
<input type="checkbox"/>				6 4 completed 2023-12-22 12:12:45

Check all With selected:

Show all Number of rows: 25 Filter rows: Search this table Sort by key: None

Query results operations

Console

USER INTERFACE

Current Location

Latitude: {{ latitude }}

Longitude: {{ longitude }}

Elevation: {{ elevation }}

Optimal Location

Latitude:

Longitude:

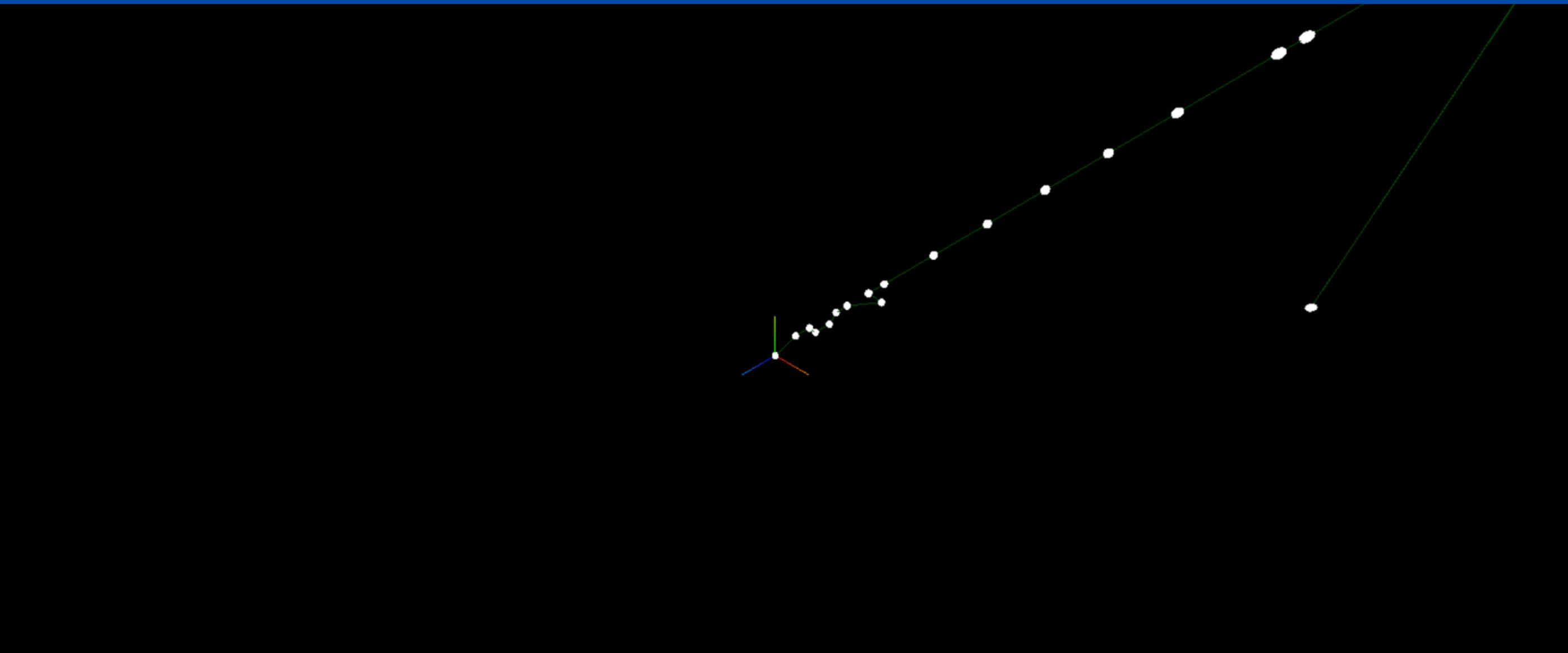
Elevation:

Depth:

Displacement Left:

Current Temperature: Loading...

PATH PREDICTION



file:///C:/Users/PARTH%20PAWAR/Downloads/tp.html

COST ESTIMATE OF OUR SMALL SCALED MODEL

COMPONENT NAME	QUANTITY	ESTIMATED COST
Raspberry Pi 4 Model B 8Gb	1	5000
Waveshare 7 inch HDMI LCD	1	5100
TF MINI LiDAR Laser Range Sensor	1	3600
NEO 7M GY-GPS6MV2	1	700
Raspberry Camera Module	1	400
SIM800A GSM Module	1	550
MPU6050	1	200
Tower PRO SG-90 Servo Motor	1	175
PCB BMP 180	1	80
Ultrasonic Sensor	1	60
TOTAL		15,865

Cost due to irregularities
in mine planning, and
dilution of ore
concentration
INR 80,000 per day

**Source: Ministry of Mines,
Schedule of Charges, 2022**

FUTURE SCOPE

1. A cloud system would be established somewhere outside the mine which has access to **Wi-Fi connectivity** so that the miner can update the Global database simultaneously using mesh network in real time.
2. We will make use of the **variations in concentration** observed in the ore body model to generate a **probabilistic ML model** which will tell us about the probability of a high ore concentration in a specific point on the map.

LIBS

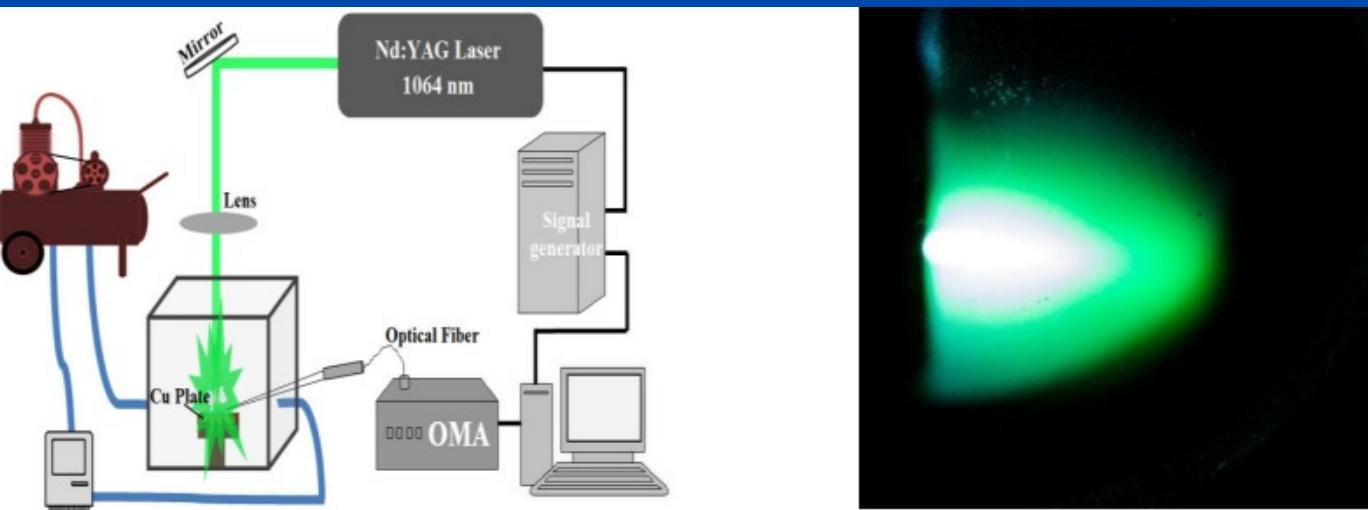
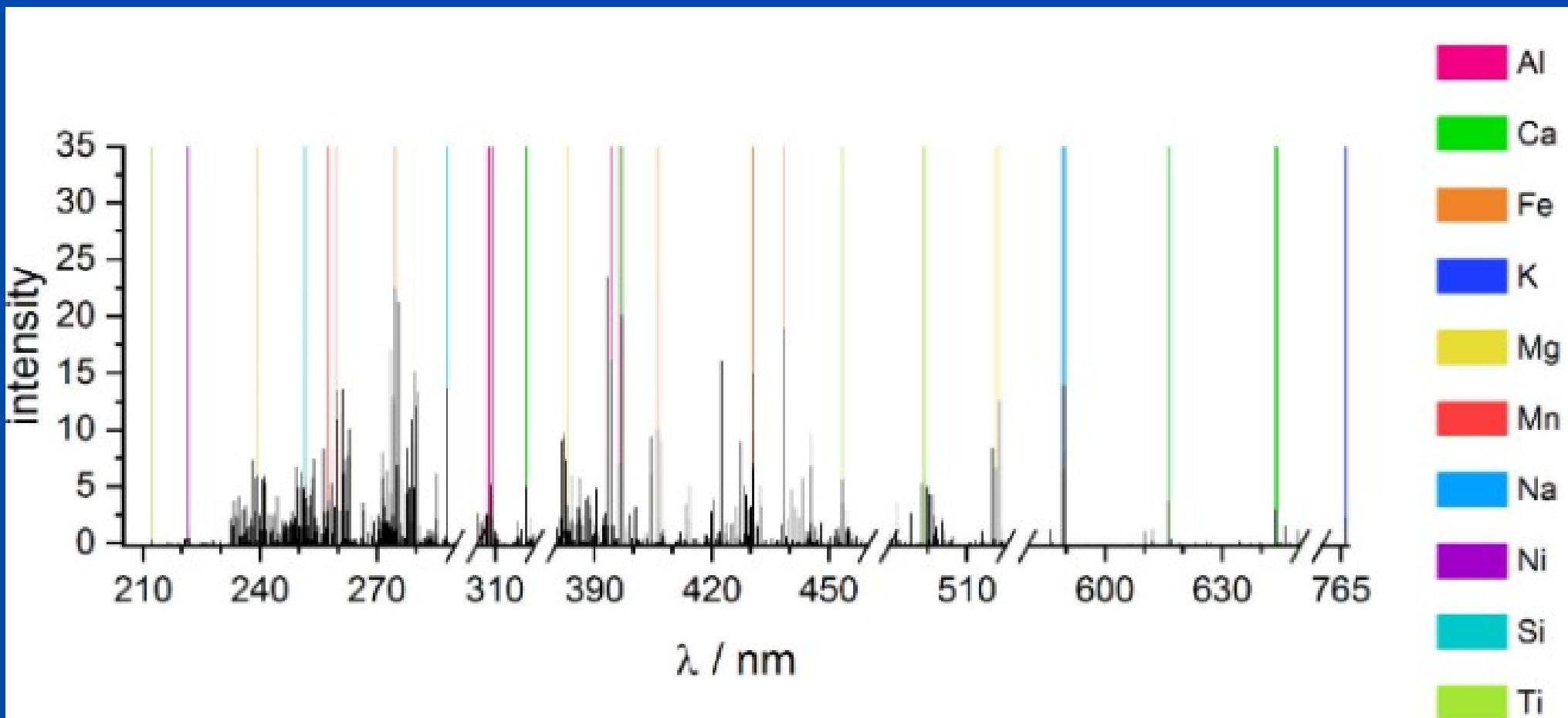
Laser-Induced Breakdown Spectroscopy (LIBS) provides real-time analysis, allowing for immediate determination of the ore grade.

1) A high-energy laser pulse is directed at the surface of the sample. This focused laser pulse generates a small, localized plasma plume.

2) The laser-induced plasma emits light as it cools down. The light emitted from the plasma contains wavelengths characteristic of the elements present in the sample.

3) Each element emits light at specific characteristic wavelengths when it transitions from excited states back to ground states. This emitted light is unique to each element.

4) Software interprets the spectral data, identifying peaks corresponding to specific elements.

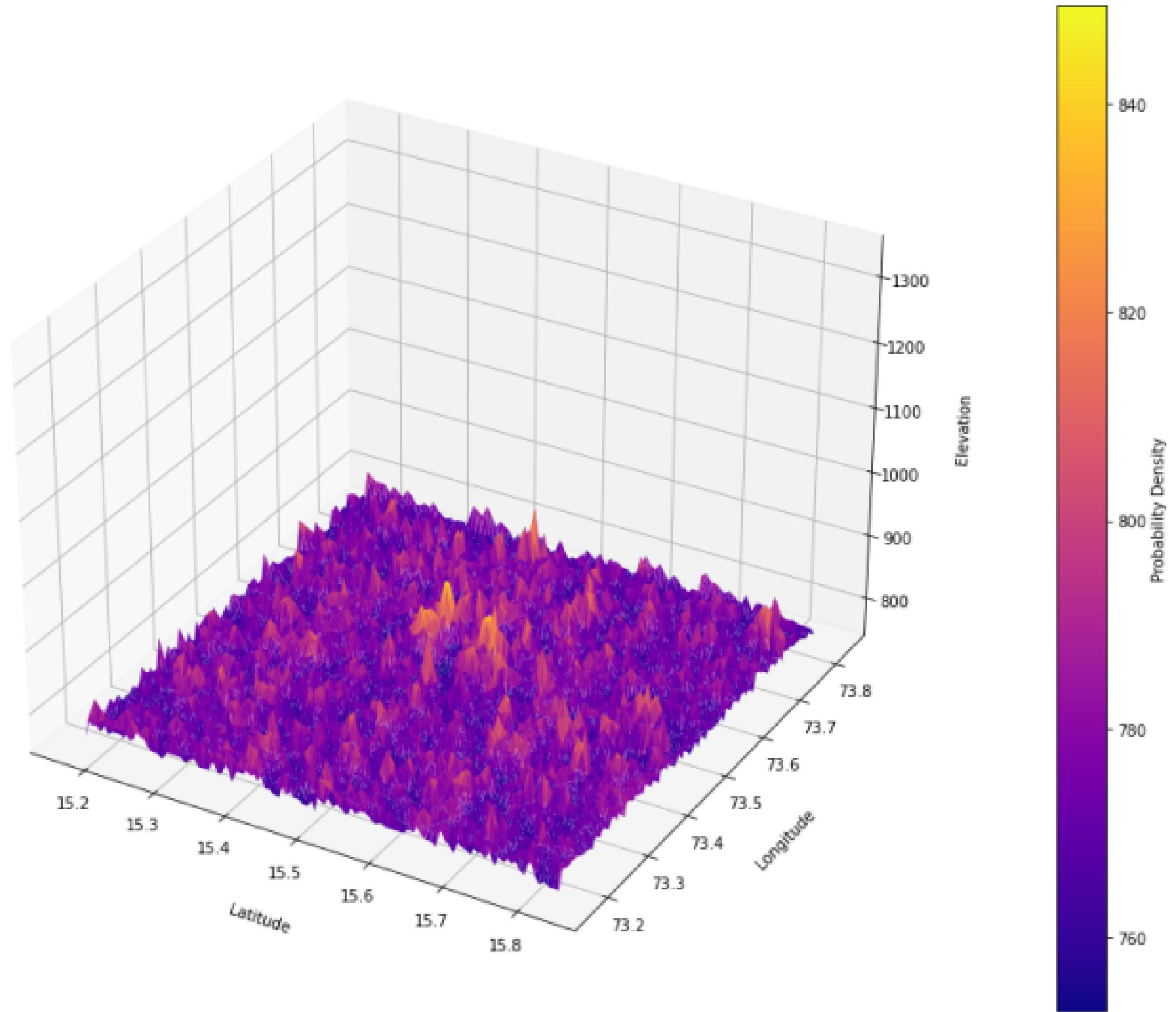


(a) experimental set-up used in this study

(b) Plasma photograph taken from the Cu plate target

Element	Emission Wavelength (nm)
Hydrogen	656.28
Helium	587.56
Lithium	610.35
Carbon	193.09
Oxygen	777.19
Sodium	589.59
Magnesium	279.55
Aluminum	394.41
Silicon	288.16
Potassium	766.49
Calcium	422.67
Iron	238.20
Copper	324.75
Zinc	213.86
Silver	328.07
Gold	242.80

FUTURISTIC PROBABILITY MODEL FOR ORE CONCENTRATION





**THANK YOU FOR
YOUR
ATTENTION**