PHASE 4

MEASURING ENERGY CONSUMPTION USING AI

INTRODUCTION

Energy consumption is a critical aspect of modern life, impacting everything from our daily routines to global environmental sustainability. This concept encompasses the utilization of various forms of energy, such as electricity, fuel, and renewable sources, to power our homes, industries, and transportation systems. Understanding energy consumption is pivotal in addressing climate change, optimizing resource utilization, and shaping the future of energy efficiency and sustainability. In this discussion, we will delve into the dynamics of energy consumption, its significance, and ways to manage it more responsibly.

Dataset for energy consumption

	Crop straw	Grass	Wood	Animal dung	Coal	Electricity	Bio-gas	Solar energy	LPG	Total
Mountainous village										
Cooking	452.45	0.00	16.64	0.00	245.08	2.24	41.43	75.03	0.81	833.68
Boiling tea	0.00	0.00	10.18	0.00	0.00	0.55	0.00	0.00	0.00	10.73
Lighting	0.00	0.00	0.00	0.00	0.00	4.98	0.00	0.00	0.00	4.98
Heating kang	380.73	240.4	0.00	125.77	31	0.97	0.00	0.00	0.00	778.87
Stove	0.00	0.00	15.17	0.00	379.15	0.00	0.00	0.00	0.00	394.32
Home appliance	0.00	0.00	0.00	0.00	0.00	7.94	0.00	0.00	0.00	7.94
Total	833.18	240.4	41.99	125.77	655.23	16.68	41.43	75.03	0.81	2030.52
Semi-mountainous village										
Cooking	184.21	75.43	44.64	0.00	457.79	1.37	0.00	97.22	0.00	860.66
Boiling tea	0.00	0.00	5.02	0.00	0.00	2.04	0.00	0.00	0.00	7.06
Lighting	0.00	0.00	0.00	0.00	0.00	7.21	0.00	0.00	0.00	7.21
Heating kang	154.48	311.15	0.00	0.00	57.72	0.00	0.00	0.00	0.00	523.35
Stove	0.00	0.00	19.65	0.00	491.9	0.00	0.00	0.00	0.00	511.55
Home appliance	0.00	0.00	0.00	0.00	0.00	11.71	0.00	0.00	0.00	11.71
Total	338.69	386.58	69.31	0.00	1007.41	22.33	0.00	97.22	0.00	1921.54
Plains village										
Cooking	64.85	87.34	35.94	0.00	583.26	1.48	0.00	114.78	5.45	893.1
Boiling tea	0.00	0.00	0.00	0.00	0.00	4.24	0.00	0.00	0.00	4.24
Lighting	0.00	0.00	0.00	0.00	0.00	9.31	0.00	0.00	0.00	9.31
Heating kang	97.63	352.28	0.00	0.00	95.95	0.15	0.00	0.00	0.00	546.01
Stove	0.00	0.00	26.98	0.00	675.39	0.00	0.00	0.00	0.00	702.37
Home appliance	0.00	0.00	0.00	0.00	0.00	11.45	0.00	0.00	0.00	11.45
Total	162.48	439.62	62.92	0.00	1354.6	26.63	0.00	114.78	5.45	2166.48

Product name	Power W	Energy loss in Feeder kWh/yr	Rectifier kWh/yr	Standby energy kWh/yr	On energy kWh/yr	Loss of enery kWh/yr	Total energy consumption kWh/yr
Light bulb	60 100	0.63	00	00	700	0.63	700
Microwave oven	800	10.11	2.30	23.50	292	12.41	315.5
Induction Stove	2000	5.69	8.61	00	1095	14.30	1095
Rice cooker	500	0.30	00	00	136.88	0.30	136.88
Coffee maker	990	0.77	00	00	180.68	0.77	180.68
Refrigerator	125	0.30	4.29	43.80	547.50	4.59	591.3
Dishwasher	500	0.22	0.79	10.27	100.34	1.01	110.60
Washing machine	500	0.37	1.36	16.83	173.38	1.73	190.21
Iron	1000	0.674			156	0.674	156
Window unit AC	900	15.32	30.97	26.28	3942	41.6	3968.28
Laptop	50	0	1.00	11.50	127.75	1.00	139.25
Personal computer	270	0.60	3.86	24.27	492.75	4.46	517.00
External Modem	7.2	00	00	7.00	13.14	00	20.14
32" LCD television	156	0.50	2.23	31.20	284.7	2.73	315.90
Total		35.48	55.41	194.65	8242.12	86.20 kWh	8436.74 kWh

Sample code

```
import numpy as np
import pandas as pd
from sklearn.linear_model import
LinearRegression

# Load your data (replace
'your_data.csv' with your dataset)
data = pd.read_csv('your_data.csv')

# Assuming your data has columns
'temperature' and
'energy_consumption'
X =
data['temperature'].values.reshape(-1,
1)
y = data['energy_consumption'].values

# Create and train a Linear Regression
model
model = LinearRegression().fit(X, y)

# Predict energy consumption for a
new temperature value
new_temperature = 25.0
predicted_energy =
model.predict([[new_temperature]])
print(f"Predicted Energy Consumption:
{predicted_energy[0]}")
```

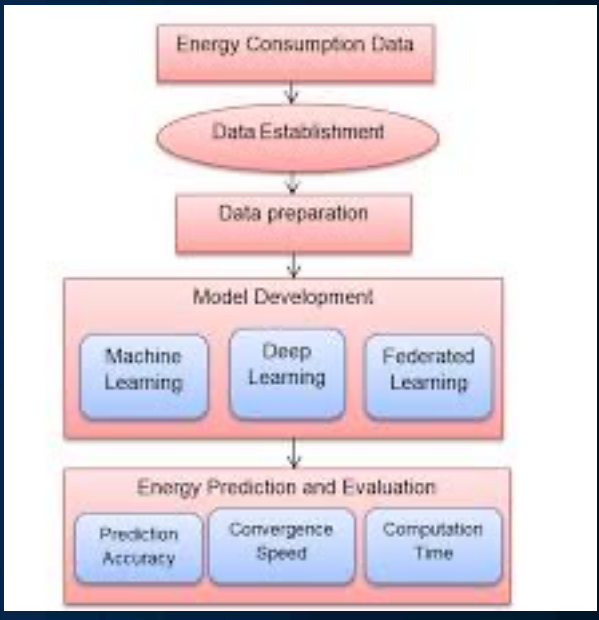
Steps for creating energy consumption model

Step 1: normality testing of dataset. In this research data analysis, a normality testing of the dataset for each tenant was conducted to determine the dataset distribution

Step 2: data pre-processing

Step 3: model development (training)

Step 4: model evaluation (test)

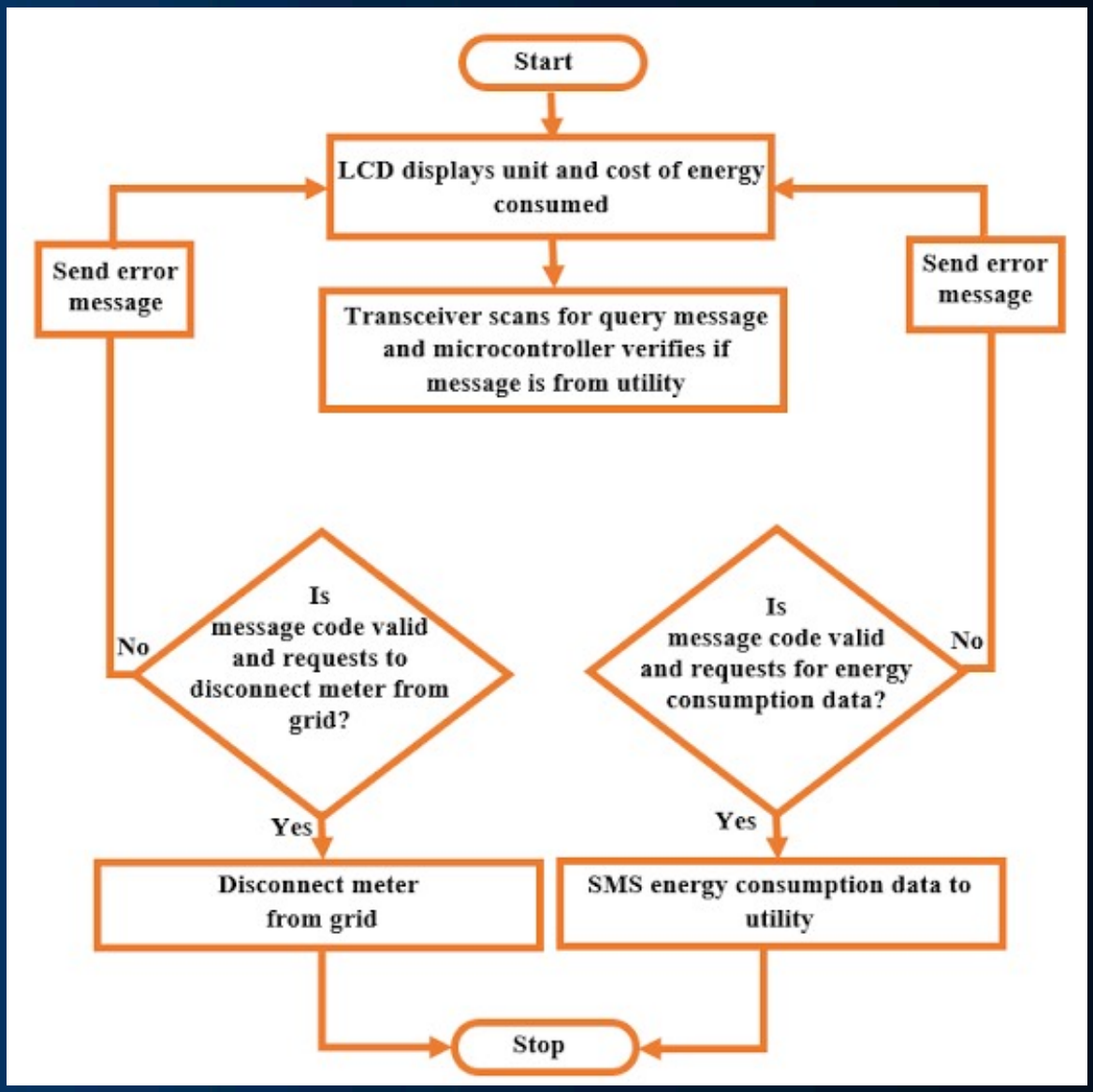


Measuring Energy consumption project

```
# Import necessary libraries
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_squared_error
from datetime import datetime
import requests
import time

# Data Collection
# Simulated data for this example
data = pd.read_csv('energy_data.csv')

# Data Preprocessing
# - Handle missing values
# - Convert timestamps to datetime objects
# - Create relevant features

# Split data into features (X) and target (y)
X = data.drop('EnergyConsumption', axis=1)
y = data['EnergyConsumption']

# Split data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,
random_state=42)

# Create and train a machine learning model (Random Forest
Regressor)
model = RandomForestRegressor(n_estimators=100,
random_state=42)
model.fit(X_train, y_train)
```

```
# Real-time Monitoring and Prediction
while True:
    # Simulate data collection from sensors (replace with actual data source)
    current_data = pd.read_csv('current_energy_data.csv')

    # Data preprocessing for real-time data
    # - Handle missing values
    # - Convert timestamps to datetime objects
    # - Create relevant features

    # Make predictions on real-time data
    prediction = model.predict(current_data)

    # Store prediction and timestamp in a database or log file
    timestamp = datetime.now()
    log_entry = {'Timestamp': timestamp, 'EnergyConsumptionPrediction': prediction[0]}
    # Store log_entry in a database or log file

    # Send the prediction to a control system or dashboard (e.g., via API)
    api_url = 'https://your-control-system-api.com'
    payload = {'Timestamp': timestamp, 'Prediction': prediction[0]}
    response = requests.post(api_url, json=payload)

    # Sleep for a specified interval (e.g., 15 minutes)
    time.sleep(900)  # 15 minutes in seconds

# In a real-world project, you would need to integrate this code with your data sources, implement robust error handling, scalability, and security measures, and deploy it on appropriate hardware and cloud platforms. Additionally, consider implementing feedback loops and advanced AI models for more accurate predictions.
```

Flow chart


Start
LCD displays unit and cost of energy consumed
Send error message
Transceiver scans for query message and microcontroller verifies if message is from utility
Send error message
Is message code valid and requests to disconnect meter from grid?
No
Yes
Is message code valid and requests for energy consumption data?
No
Yes
Disconnect meter from grid
SMS energy consumption data to utility
Stop

Conclusion

Measuring energy consumption is a critical endeavor with far-reaching implications for both individuals and society as a whole. It enables us to understand and ontimize the use of valuable resources while contributing to environmental sustainability.