Streetlight Projection

Names have been redacted for privacy at the request of the team. Further details may be disclosed upon formal request.

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Problem Statement

1.Outages: A City-Wide Paralysis

- Power outages are major disasters that can paralyze entire urban infrastructures.
- Proactive prevention and early warnings are the keys to public safety.

2. The Limitation of "Digital-Only" Alerts

- Current alert systems rely heavily on Text Messages & Mobile Apps.
- Information Inequality: Highly effective for the general public, but restrictive for others.

3. Who is Left Behind?

- Seniors: Unfamiliar with complex mobile technology.
- Travelers: Face language barriers and lack of local network access.

4. The Core Obstacle

- This "Information Blind Spot" is a major barrier to an inclusive and effective emergency response.

Solution

- **Infrastructure-based Solution:**
  - Bridges the digital divide by leveraging existing streetlight infrastructure, ensuring access without smartphones.
- **Universal Visual Language:**
  - Uses pictograms (arrows, icons) to eliminate language barriers, allowing for immediate intuitive understanding.
- **Hyper-Local Alerts:**
  - Fixed streetlights ensure warnings match the exact location, unlike broad mobile alerts.
- **Role of AI:**
  - Uses pre-trained Machine Learning Model to project warning

Normal Mode (<30% Risk)

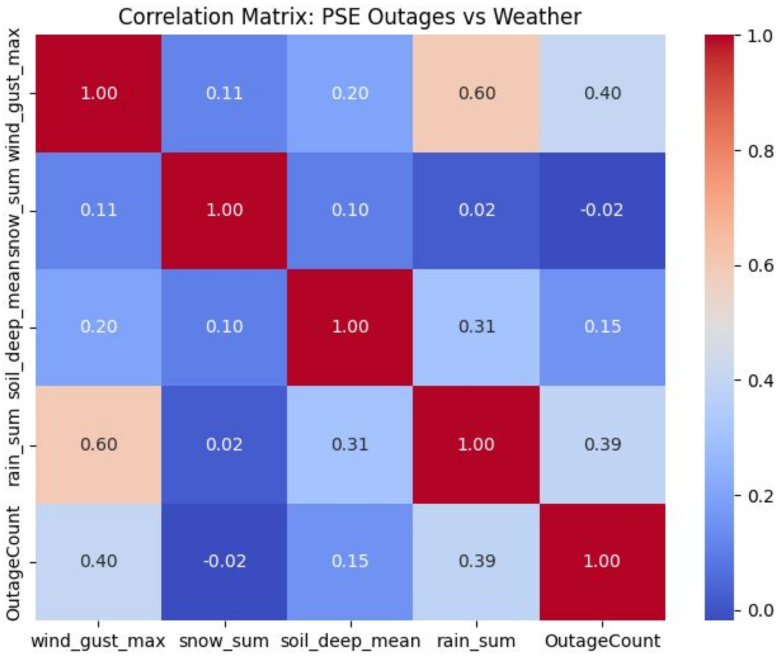
Emergency Mode (>80% Risk)

Implementation

- The ML model takes historical outage data (from PSE and Seattle City Lights Open Database) and meteorological variables (wind speed, precipitation, soil saturation etc)
    - Finds patterns
    - Develops a prediction model
- Takes weather forecast data for the next week and predicts probability of power outage
- Forecast calls to pre-trained model
- User Interface (streetlight projection) calls to service to know what to project
    - Phase 1 (Normal / <30%): Projects aesthetic patterns (e.g., leaves, geometric shapes) for urban ambiance.
    - Phase 2 (Warning /60%~80%): Projects caution lines or text ("High Load") to alert pedestrians.
    - Phase 3 (Emergency / >80%): Projects universal emergency pictograms (e.g., fire icon, flood icon, running man) accompanied by short explanatory text (e.g., "Fire Nearby", "Do Not Enter") to instantly communicate the situation.

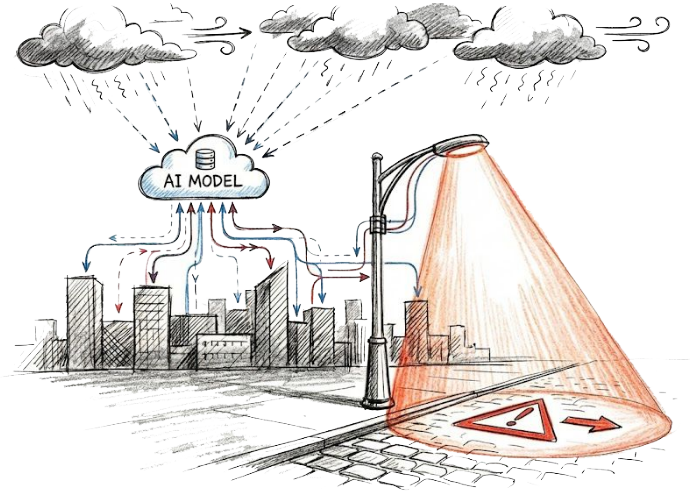
Implementation

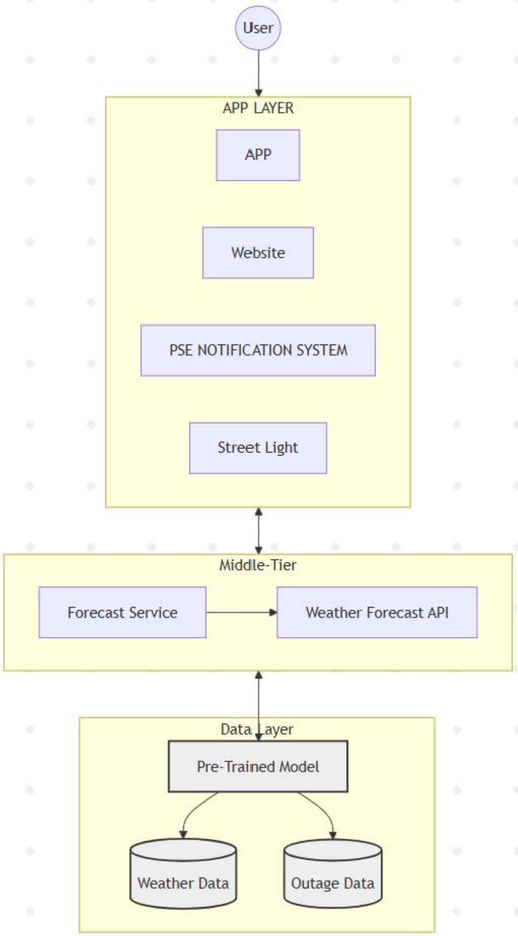
- The correlation matrix shows that the two features that are most related to outage count are wind_gust_max (wind speed) and rain_sum (rainfall amount)
- Therefore, these are the two main features that the ML model will be evaluating to predict power outages.



Model Type	Operational Role	Precision	Recall	F1-Score	Interpretation
Wind Outage	Yellow Alert	0.47	0.43	0.45	**Balanced**. Alerts are meaningful but require human verification. Captures ~43% of specific wind events, but missed events are usually minor.

Implementation Architecture





Why this Solution is Unique

- Existing tools are **descriptive** (showing current outages). Our tool is **predictive**.
- We leverage the Google Gemini API to translate complex probability data into clear, natural-language safety projections for users, making the interface (streetlight projections) accessible to all populations (including seniors and foreign visitors)
- Power Outages in NW Washington (Puget Sound) are caused by a combination of soil saturation and wind speed, not just wind
    - This is due to the large amount of vegetation
- By using a model that accounts for these two features, we create a prediction model that is unique to the Puget Sound Area

Impact

1. Saving Lives

- **Before:** Sudden outages cause life-sustaining medical equipment (e.g., oxygen concentrators) to fail, leading to critical emergencies.
- **After:** A **48-hour advance alert** provides the essential **"preparation time"** needed to charge backup batteries or arrange safe medical transport.
- **Impact:** Achieving **Zero Fatalities** from power-related health crises.

2. Economic Impact

- **Before:** A single outage can lead to massive losses as grocery stores and restaurants are forced to discard spoiled inventory (thousands of dollars in losses)
- **After:** Businesses can trigger **inventory protection protocols**—such as deploying refrigerated trucks or dry ice—immediately upon receiving the prediction.
- **Impact:** Preventing financial ruin for local businesses and **safeguarding the local economy**.

3. Operational Efficiency (Faster Restoration)

- **Before:** Crews start locating damage only *after* the outage occurs, delaying restoration by days.
- **After:** With AI predicting exactly where a pole will fall, restoration crews are **pre-staged** at high-risk zones before the storm hits.
- **Impact: Dramatically reduced downtime** and rapid restoration of essential city functions.

Why It Matters

Human Equity & Safety

- Accessibility for all
- Critical lead time
- Universal intuition

Operational & Economic Recovery

- Reduces 911 congestion
- Mitigating economic loss
- Optimizing restoration

Strategic Innovation

- Smart City Evolution
- Eliminating alert shortage
- Scalable Future