BTP:

Android App Development For Prediction, Scheduling and Cost Calculation of a Generating Station

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Abstract

Various electrical parameters in a power plant are calculated through smart energy meters. These meters upload the data to a server and our android app is used to retrieve it.

Multiple parameters are then calculated within the app. These parameters include DSM (Demand Side Management) charges for each time block, the total charges for a day, additional penalties if there is sustained deviation for more than 12 consecutive time blocks.

Finally, we are required to predict future scheduled generation on the basis of past actual generation as a means to minimize the difference between the two, and consequently, to minimize costs.

Introduction

Electrical power is supplied from sellers to buyers. This distribution of power is determined by a number of constraints based on price and other parameters. Two important parameters are the actual generation (AG) and the scheduled generation (SG).

Sellers generate electricity as per a schedule dividing a day into 96 blocks of 15 minutes each. However, the buyer can demand more than the scheduled amount of power. This leads the seller to incur a loss, consequently slowing the generator blades as mechanical power is converted to electrical power, this loss must be compensated. Alternatively, since the consumer used more electricity than they were allotted, they should pay extra.

Charge for deviation for all time blocks are payable for overdrawal by the buyer and underinjection by the seller; Similarly, charges are receivable for underdrawal by the buyer and over-injection by the seller. However, the seller can choose to overinject as much as he wants; or the buyer can underdraw as much as he wants to get paid more. As a result, charges for deviation in excess of min(12% of SG, 150MW) are 0.

Terms Used

- Time block: Each day is divided into 96 time blocks of 15 minutes each.
- Scheduled Generation (SG): It refers to the power which is scheduled to be provided by generators.
- Actual Generation (AG): It refers to the power which is actually consumed by the buyers or provided by the sellers.
- Declared Capability -It is a measure of the contribution that a power station makes to the overall capacity of a distribution grid.
- Android WebView :- Built in browser in android SDK.
- DOM :- Document Object Model.

Limitations of the current method

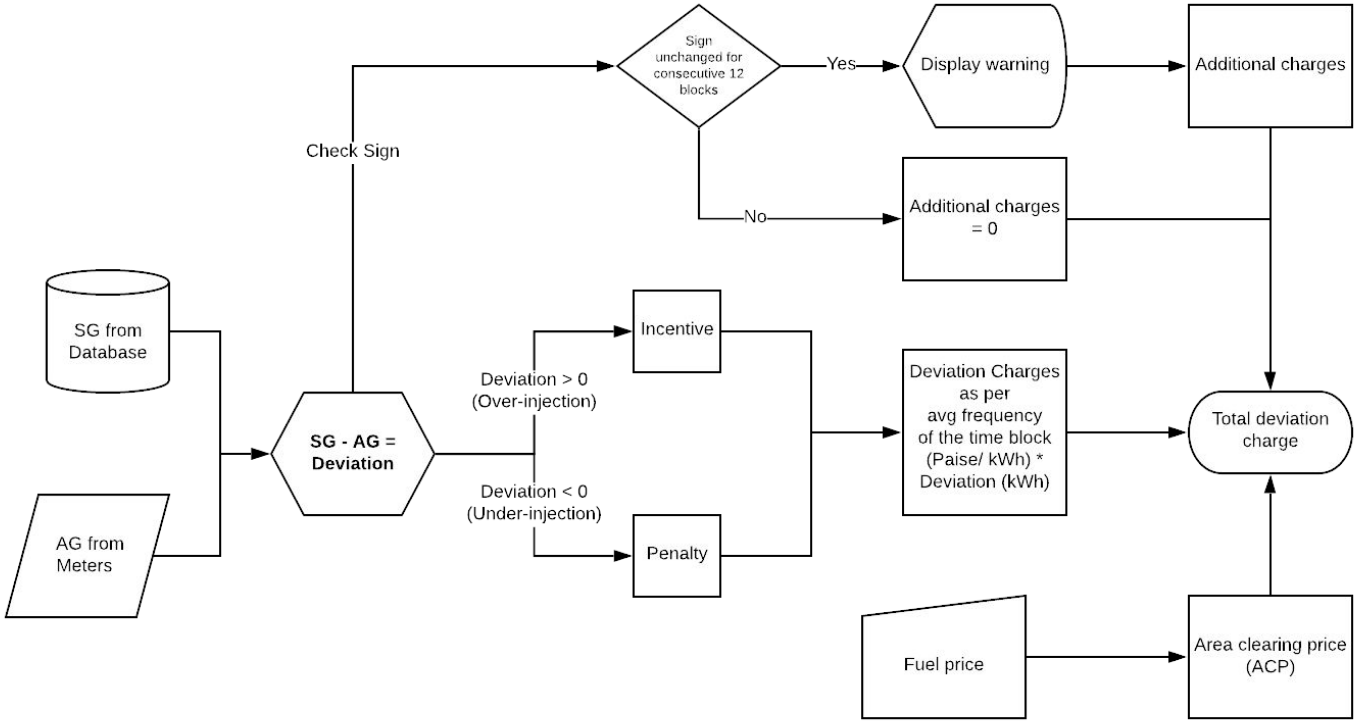
- The present model requires the generators to operate on a schedule which is developed one day earlier. As an example: if the SG is 150MW but the AG is only, say, 10MW, the seller would continue to generate the excess power. This would lead to both financial and energy loss.

  To counter this, the app replaces the 1-day interval to 1-block interval. Excluding sudden changes in power consumption, this would allow deviations to be reduced.

- The server (or computer) on which data is uploaded can be accessed only by being physically present in the room in which it is stored. However, one may be required to access this data at any time.

  This task is simplified through the app which allows one to access data anywhere.

For each time block



Approaches for App Development

Based on the availability of resources from the plant, the following are the two possible approaches as per the dependency of the function of the APP

Dependency on WebApp.

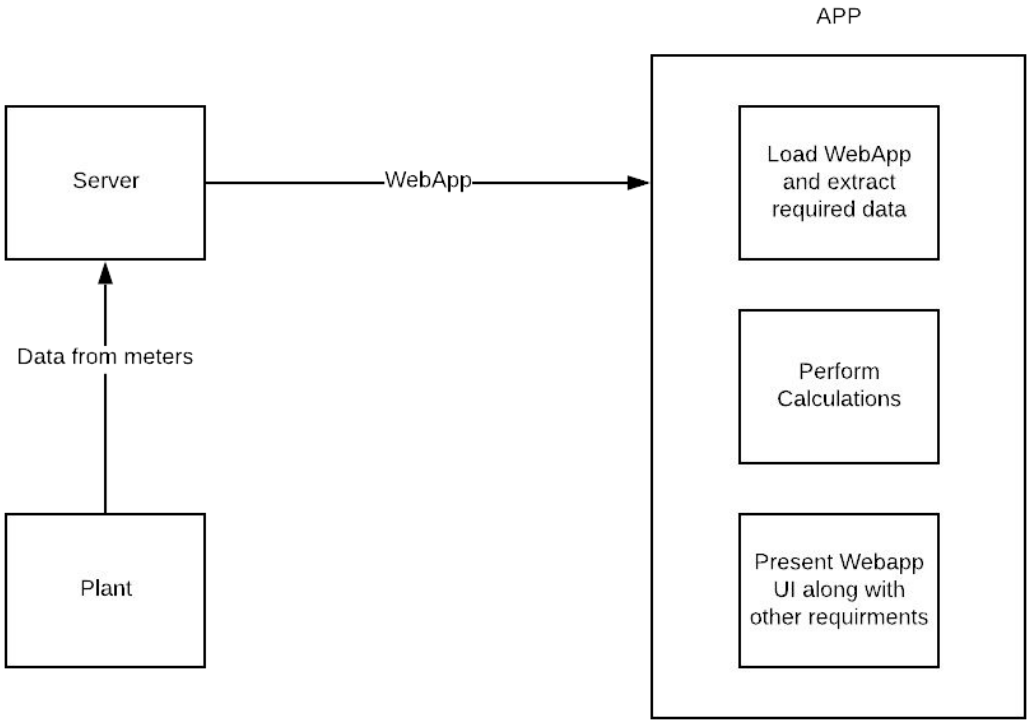
Dependency on Data API.

Dependency of Webapp

The developed application will be dependent on the WebApp for its functioning. The WebApp will be loaded using android WebView and the WebApp UI will be shown in a section in android app. Additional required services will also be added. We will use HTML DOM of the loaded page to get data for the added services for that particular page.

The added services may be buttons redirecting to payment portals and any additional information pages, these will be designed and configured according to the requirements.

FlowChart

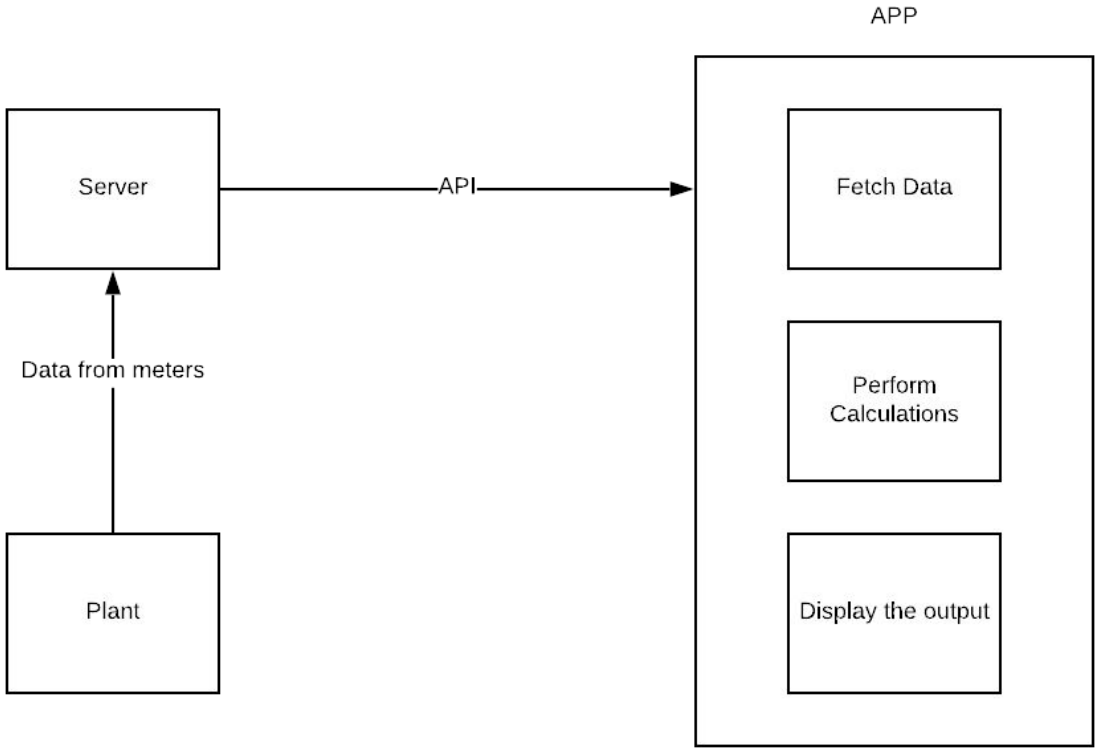

APP
Server
WebApp
Load WebApp and extract required data
Perform Calculations
Present Webapp UI along with other requirments
Data from meters
Plant

Dependency on Data API

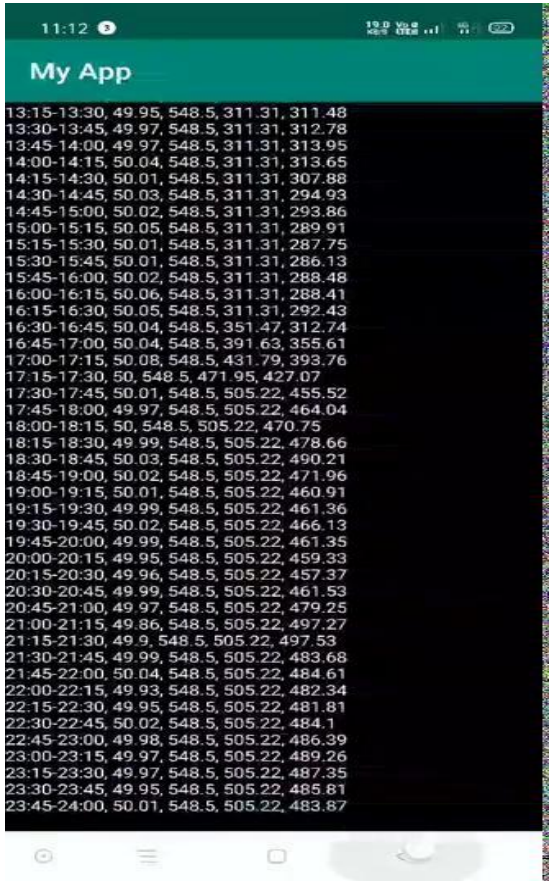
In this Approach the developed Application will be mainly dependent on Data Api for its functioning. We will add services and design the complete UI of the app without being dependent on the website, we can Add/Hide columns of the generation block tables. We will be contacting the provided Api for getting the generation block data. In this case even if the website crashes or brought under maintenance the developed android app will work perfectly fine.

Similarly the defined services in previous approach can be added easily and with much more flexibility.

FlowChart


APP
Server
API
Fetch Data
Perform Calculations
Display the output
Data from meters
Plant

Current App


11:12
My App
13:15-13:30, 49.95, 548.5, 311.31, 311.48
13:30-13:45, 49.97, 548.5, 311.31, 312.78
13:45-14:00, 49.97, 548.5, 311.31, 313.95
14:00-14:15, 50.04, 548.5, 311.31, 313.65
14:15-14:30, 50.01, 548.5, 311.31, 307.88
14:30-14:45, 50.03, 548.5, 311.31, 294.93
14:45-15:00, 50.02, 548.5, 311.31, 293.86
15:00-15:15, 50.05, 548.5, 311.31, 289.91
15:15-15:30, 50.01, 548.5, 311.31, 287.75
15:30-15:45, 50.01, 548.5, 311.31, 286.13
15:45-16:00, 50.02, 548.5, 311.31, 288.48
16:00-16:15, 50.06, 548.5, 311.31, 288.41
16:15-16:30, 50.05, 548.5, 311.31, 292.43
16:30-16:45, 50.04, 548.5, 351.47, 312.74
16:45-17:00, 50.04, 548.5, 391.63, 355.61
17:00-17:15, 50.08, 548.5, 431.79, 393.76
17:15-17:30, 50, 548.5, 471.95, 427.07
17:30-17:45, 50.01, 548.5, 505.22, 455.52
17:45-18:00, 49.97, 548.5, 505.22, 464.04
18:00-18:15, 50, 548.5, 505.22, 470.75
18:15-18:30, 49.99, 548.5, 505.22, 478.66
18:30-18:45, 50.03, 548.5, 505.22, 490.21
18:45-19:00, 50.02, 548.5, 505.22, 471.96
19:00-19:15, 50.01, 548.5, 505.22, 460.91
19:15-19:30, 49.99, 548.5, 505.22, 461.36
19:30-19:45, 50.02, 548.5, 505.22, 466.13
19:45-20:00, 49.99, 548.5, 505.22, 461.35
20:00-20:15, 49.95, 548.5, 505.22, 459.33
20:15-20:30, 49.96, 548.5, 505.22, 457.37
20:30-20:45, 49.99, 548.5, 505.22, 461.53
20:45-21:00, 49.97, 548.5, 505.22, 479.25
21:00-21:15, 49.86, 548.5, 505.22, 497.27
21:15-21:30, 49.9, 548.5, 505.22, 497.53
21:30-21:45, 49.99, 548.5, 505.22, 483.68
21:45-22:00, 50.04, 548.5, 505.22, 484.61
22:00-22:15, 49.93, 548.5, 505.22, 482.34
22:15-22:30, 49.95, 548.5, 505.22, 481.81
22:30-22:45, 50.02, 548.5, 505.22, 484.1
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23:00-23:15, 49.97, 548.5, 505.22, 489.26
23:15-23:30, 49.97, 548.5, 505.22, 487.35
23:30-23:45, 49.95, 548.5, 505.22, 485.81
23:45-24:00, 50.01, 548.5, 505.22, 483.87

Future Work

It is necessary to minimize deviations in order to optimize costs. One way of doing this is to schedule the power generation (SG) on the basis of trends in power consumption (AG).

The pending development of the app will be finished as per the decided approach.

A machine learning model will be connected with the app which, on the basis of trends or patterns in past data of AG would predict values of SG for future time blocks. It will be able to predict these values for any block. The sellers could then check these values and schedule generation accordingly.

Calculations

Frequency(Hz)	UI Rate	DC(MW)	SG(MW)	AG(MW)	DC-SG(MW)	AG/SG(%)	Deviation(MW)	Deviation(%)	Deviation Charge	...	Total Deviation & Additional Charge	Fuel Cost	Net Gain/Net Loss	Opportunity Dev
49.92	303.040	548.5	311.31	297.54	237.19	95.576756	-13.77	-4.42	-10432.15	...	-10432.0	10844.0	412.0	-39.313631
50.02	238.904	548.5	311.31	293.54	237.19	94.291863	-17.77	-5.71	-10613.31	...	-10613.0	13994.0	3381.0	-39.313631
50.01	238.904	548.5	311.31	294.81	237.19	94.699817	-16.50	-5.30	-9854.79	...	-9855.0	12994.0	3139.0	-39.313631
49.98	303.040	548.5	311.31	296.20	237.19	95.146317	-15.11	-4.85	-11447.34	...	-11447.0	11899.0	452.0	-39.313631
49.93	303.040	548.5	311.31	296.12	237.19	95.120619	-15.19	-4.88	-11507.94	...	-11508.0	11962.0	454.0	-39.313631
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
49.98	303.040	548.5	505.22	486.39	43.28	96.272911	-18.83	-3.73	-14265.61	...	-14266.0	14829.0	563.0	-50.521615
49.97	303.040	548.5	505.22	489.26	43.28	96.840980	-15.96	-3.16	-12091.30	...	-12091.0	12569.0	477.0	-50.521615
49.97	303.040	548.5	505.22	487.35	43.28	96.462927	-17.87	-3.54	-13538.31	...	-13538.0	14073.0	534.0	-50.521615
49.95	303.040	548.5	505.22	485.81	43.28	96.158109	-19.41	-3.84	-14705.02	...	-14705.0	15285.0	580.0	-50.521615
50.01	238.904	548.5	505.22	483.87	43.28	95.774118	-21.35	-4.23	-12751.50	...	-12752.0	16813.0	4062.0	-50.521615

References

- Letter to Generators SCED (Dated 18 April 2019) - POSOCO
- DSM 5th Amendment (Dated 28 May 2019) - Central Electricity Regulatory Commission
- Notification 132 (Dated 6 January 2014) - Central Electricity Regulatory Commission

Thank You