# **Consumption management**

## **The goal of this solution**

This project helps people save money on their utility costs and protect the environment at the same time, by helping them manage their utility usage more efficiently.

We are not simply creating a smart home, where switches and other devices are doing their routine jobs.

Our solution is a comprehensive system, where users can track their utility usage, and the results of their money spent on utilities.

Using this data we can create reports, make predictions and suggest actionable insights that enable users to optimize their utility usage.

## **Operational principles**

Automatic reading of utility meters using computer vision software and efficient camera hardware. Tracking the efficiency of the used utilities in your home, using custom hardware designed by us.

The required data is collected using a mix of our own sensor packages and off the shelf components, communicating with each other, throughout your home.

## **Deployment**

The users can easily mount the required camera hardware on their utility meters. Following which the main mounted devices discover other nearby deployed sensor packages. Only these main devices communicate with our servers in the cloud, after collecting the data from the user's local network. The data is processed on our servers, and the users can discover the insights produced by the solution, using their favorite mobile devices, or our website.

The main reasons behind using Wi-Fi for the inter-device communication, are that the target locations being family homes, which are limited in size; that the network is generally already available; and that it requires the least amount of user configuration.

## **Technologies**

We use mostly off the shelf components, and add some of our own:

* Meter reader
  + ESP32 CAM
  + 3D printed or injection molded housing
  + Power supply and cable
  + Optional two piece battery pack, with charger and housing module
  + SD Card
  + LED

We use this off the shelf module, because it's affordable, has built-in Wi-Fi, is capable of running the required neural networks (required to accurately read the meters), so no sensitive data has to leave the local network. The SD card can be used to store configuration and log files. For deployments without nearby power availability, a version with built in, user replaceable batteries is available, with an estimated operating time of ~170 days.

* Sensor package
  + ESP12-F
  + Temperature sensor
  + Light sensor
  + PCB
  + 3D printed or injection molded housing
  + Power supply and cable
  + LED

Ideally the user would place one of these in every room. It is used to keep track of the room's temperature and ambience level. In the future, you will even be able to place one in your pool!

During development our main goals were the following:

* Minimal costs
  + No unnecessary serial ports
  + Each component is SMD, movable by PNP machines
  + One-sided, double layered PCB

#### **Miscellaneous features**

* Has two LEDs for enhanced user feedback and experience
  + One controllable by the ESP, the other is the 5 volt status
  + Estimated power consumption: 10mA, when removed the accuracy of the light sensor improves
* The sensor has a pinout, so further modularity is achievable in the future
* All pins of the ESP are available
  + I2C, UART, SPI are accessible, ensuring future expandability
* Some of the GPIO pins are free, enabling control
* Same bus track lengths for SPI, I2C and UART
* 3, 2-mm holes for mounting screws
* There is no ground near the antenna

## **Main functionalities**

* Consumption trends: How has your utility usage change in a given time period?
* Ideal temperature calculation: What is the ideal temperature for your home, based on your preferences, usage and other metrics. Avoid diminishing returns. What is the most cost efficient temperature for your home, when you leave it for a time period, whether it be a day at the office, or a weekend with family.
* Cost forecasting: Warn the user when they are about to overspend on their utility budget. Predict their likely utility costs.
* Prevent wasteful usage: Warn the user when a light is on when the house is empty.

Possible future improvement plans include integrating the solution with popular open source solutions, such as Home Assistant.