

How to Deliver Power to the Smart Parking Meter

Introduction

Parking meters are a big hassle for commuters on a day to day basis. Often it is incredibly hard to find open street parking in cities. This forces the driver to drive in circles looking for a spot or waiting for one to become open. Meterrific's solution to this problem is to create a smart parking meter and an app to visualize open parking spots. The smart parking meter will be able to detect if there is a car in its parking spot using a distance sensor. It will then inform the database of its availability. The database will feed a visual representation of all open parking spots to a mobile app to be used by customers. The customer will then be able to reserve a parking spot and the app will navigate the customer to that specific parking spot. One of the design considerations for the parking meter is how to power it. This paper reviews the different methods for powering the parking meter and how the systems for powering the meter work.

Components of Parking Meter

Smart parking meters have a lot of components to provide a host of features. These components all require power. The MPS Sentry Meter has a speaker, a front-facing camera, a microphone, a touch screen lcd display, a credit card reader, a coin slot and many other components. The meter also has a puck installed in the pavement of each parking space to sense a vehicle. This parking meter is powered by 48V DC power. It gets this power from a hardwired central power distribution unit that converts 120V AC to 48V DC [7]. The MPS Sentry Meter requires a hardwired connection which could be eliminated with solar power.

Solar Power

To power a parking meter, a power supply unit is necessary. IPS Group Inc. has a patent on a Power supply unit for parking meters which utilizes solar power. The unit has a main battery which is rechargeable and a charging arrangement for the battery. The unit also has a non-rechargeable back-up battery and a control unit to load power from either of the batteries. The unit charges the main battery with solar panels and allows the back-up battery to be easily replaceable [8].

This patent demonstrates a great way to power parking meters. Solar panels charge the main battery of the unit, but solar energy is not always adequate as shade or weather can hamper the panels from generating enough energy. Because of this problem, the unit has the back-up battery. The problem with the patent is that the back-up batteries must be replaced often for the unit to be always operational. This brings with it a maintenance cost along with the cost of new batteries.

A report from the City of Sacramento details the procedure for charging the batteries for the IPS single-space smart meter. This meter uses the same power supply unit as detailed above or a very similar one. The report details that for the unit to be function the system requires the battery to be above 3,100 mV. The main battery can be charged with external power if the battery voltage falls below that threshold due to insufficient solar power. The backup battery also is required to be above 3,100 mV, if it falls below that threshold, then the battery will have to be replaced with a new one. The meter can communicate with IPS's Data Management System which houses the list of battery levels for all parking meters. It can inform the maintenance staff about which meters need their batteries replaced [9].

The documentation of the Amano MSM Sprite multi-space terminal gives us another example of a solar parking meter. It requires an operating voltage of 12v DC. It has a 26 Ah main and back-up battery. The main battery is charged with solar panels. The backup battery operates with 110v AC which can be delivered from a street lighting supply [2]. This solution does not require the main battery to be manually charged or for the back-up battery to be replaced.

Power Consumption

To make sure that solar panels can supply enough energy, the power consumption of the parking meter must be computed. Kulesza's senior thesis discusses the power consumption of a parking meter and the power generated by solar panels. A parking meter prototyped with "an Arduino MEGA 2560, CC3000 Wi-Fi Module, ArduCAM 2MP camera, HC-SR04 Distance Sensor, 8x 1.2V 2000mAh NiMH Battery Holder and batteries, LED Display, and 2x 12V 45mA Solar Panels." The system was tested with an average condition of system on time at 5.33 hours per day. The system consumed 12.00 Wh per day. This is above the 1.08 Wh per day energy generation of the two solar panels. By replacing the Arduino with the more efficient ARM Cortex-M0+, the system consumption dropped to 0.47 Wh per day [3]. This new power consumption was well within the power generation of the solar panels. The thesis demonstrates the need to be uber efficient with the components of the board to consume as little power as possible.

Cost of Parking Meters

The Allentown Parking Authority requested \$622,788 for the installation of 63 Amano MSM Sprite pay stations [10]. This would put the price of buying and installing one Amano meter at \$9,885.52.

The Metropolitan Area Planning Council lists the cost of purchasing different IPS parking meters. This does not include installation cost. The cost of the single-station solar powered IPS parking meter is \$495.00. The cost of the multiple-station solar powered IPS parking meter is \$5,950.00. The cost of the multi-station hardwired IPS parking meter is \$6,150.00 [11]. This illustrates that the base cost of the IPS

solar parking meter is cheaper than their hardwired one. It also illustrates that the parking meters can have wildly different prices based on their scope.

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