

# Integration of Smart Meter with OCC

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**Abstract**—For collecting power consumption profile, the massive popularity of smart meters poses a large amount of fine-grained energy consumption data. Particularly on the delivery side management, the deregulation of the power generation grid has ever been moving ahead globally. Smart meter has saved both time and energy in the energy trading process. However, sending the electricity bill to the consumer can also be avoided using optical camera communication. If LEDs are placed on the smart meters, they can transmit data that can be received with mobile phone's camera. Therefore, our proposed scheme is able to completely replace the conventional billing system.

**Index Terms**—Smart meter, automatic meter reading, optical camera communication.

## I. INTRODUCTION

Around the world, smart meters (SM) have been introduced during the past decade. By the end of 2016, the numbers of SM deployed in the U.S., the U.K., and China reached 2.9 million [1], 70 million [2], [3], and 96 million, respectively. In the process of consumption, generation, and transmission, the power sector has undergone remarkable improvements of data analysis. Different project running on SM data analytics have also been introduced increasingly.

Now-a-days, SM is very popular and used in almost every home and industry. It can record information about consumption of electric energy, voltage levels, current and power factor. It can monitor the electricity consumption in real time and also eliminate manual monthly meter readings. Developing the feature of SM, it has enormously facilitated both the consumer and supplier. Complication in system monitoring, billing and customer nature has been reduced. Bi directional communication system between the meter and supplier gives superiority than automatic meter reading (AMR). However, there can be a considerable amount of meters in a house. Again, the location of the meters may not always be in an open space or accessible position. The current meter reading and monthly bill can be easily sent to the consumer using an emerging technology called optical camera communication (OCC) with minimum additional cost.

LEDs and camera are used as transmitters and receivers, respectively in OCC. Data are sent in the form of light signals and camera captures those LED states. Data can be decoded using different image processing techniques [4]. An LED array can be placed on the smart meter as a transmitter. Camera has the ability to spatially separate all the lights of a LED

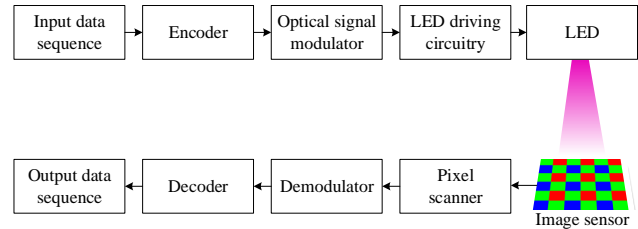


Fig. 1. Basic operating principle of OCC.

array. It highly facilitates achieving higher data rates. The main contribution of this paper is presented here

- Integration of LED matrix in the SM, that transmits the consumption profile, voltage levels, current and power factor, and especially, the total electricity cost information in a month.
- From the LED matrix, then smart phone gathers the billing information. Then, it sends the electricity bill to the certain bank to the belongs to the particular company

The rest of the paper is organized as follows: Section II shows systems architecture of the proposed model. In the final section, we have finished with conclusion and future work.

## II. SYSTEM ARCHITECTURE

A smart electronic device is known as SM that communicate the information to the user for greater clarity of demanded profile, and power suppliers for customer billing and system monitoring. Throughout the day, SM typically record and report power profile near real-time regularly for short intervals. SM focuses two-way communication between the meter and the central control system. According to the SM technology, the daily load profiles can be monitored. The consumed energy profiles, voltage levels, current condition, and power factor at any moment can be determined.

Afterwards, the numeric data will be transmitted by using LED matrix. Therefore, Android mobiles, an essential part of day to day modern life can facilitate this data reception process. Both the front and rear camera can be used as a receiver [5]. A LED array will be placed in front of the meter. These LEDs will transmit the necessary information in the form of light signals. The data transmission speed is limited

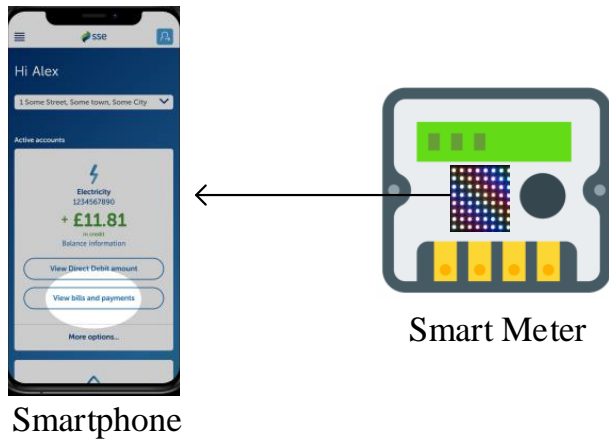


Fig. 2. SM data flow by using OCC.

by the frame rate of the camera. The frame rate of the low-cost commercial camera is only 30 fps. To fulfill the Nyquist sampling criteria, there will be light flickering, which is very uncomfortable to the human eye. Hence, the data is modulated with an appropriate modulation technique to make the bit rate over 100 Hz so that the human eye can't perceive [6]. Different modulation schemes, such as UFSOOK, UPSOOK, etc. can be applied [7]. Therefore, the current electricity bill and month-end electricity bill can be easily received with a mobile phone's camera without any flickering. The proposed system has been shown in Fig. 2.

### III. CONCLUSION

In this paper, we have proposed a new architecture of SM where the smart phone can easily access to get the provided information by the SM. As conventional metering system, hard copy bills are sent to every consumer. This laborious process can be replaced with online payment after integrating our proposed scheme with very little additional cost.

### IV. FUTURE WORK

This work can also be extended to get the real-time current, voltage, and power factor data. Again, the energy of the LED transmitter can also be saved by detecting whether there is any person to collect the data or not using sensors.

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