ABSTRACT
As power dissipation and time constraint have become vital challenges during the creation of a digital circuit, researchers’ and designers’ efforts have increased to figure out new ways of preserving power through the study of its sources and its impacts as well as through the decrease of response time to obtain faster treatments. However, it is widely acknowledged that these two parameters are antagonistic in synchronous systems. In fact, current technologies have managed to further decrease the response time to have a faster circuit at the cost of a considerable simultaneous augmentation in its power or vice versa, which leaves no option for designers but to choose from these two important parameters. Hence, the main objective of this chapter is to propose a design method that simultaneously builds a low power design and provides a faster circuit. For the achievement of that purpose, a controller based on a finite state machine (FSM) has been chosen as an example of synchronous system to prove that the new proposed design can optimize both parameters: time and power.

INTRODUCTION
Power consumption has become one of the most important parameter while designing a digital system. In fact, according to the International Energy Agency, electricity consumption is expected to increase by up to 75% between 2007 and 2030. The average annual increase in global electricity consumption will be about 2.4%. This critical growth is now the overriding responsibility for more than 40% of greenhouse

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Typical Design of Synchronous Controller to Minimize Response Time and Power

gas projections. Thus, a universal awareness in all sectors is observed in order to implement new solutions to solve such problem. In this context, the designers of electronic systems adhere to the efforts of the universal community to develop appropriate methodologies and techniques in order to obtain less consuming systems.

The power consumption affects many sectors and levels such as: the socio-economic level and the technological one. Concerning the socio-economic level, it is observed that with the increase of electricity prices, the power consumption of several informatics, electrical, microelectronic and domestic equipments has become a major concern. Consequently, media mobilization is necessary in order to evolve behaviors and mentalities.

In addition, social and political action plans are being implemented and focused on optimizing the average per capita energy consumption rate. This rate differs from one country to another and reaches its peak in countries with strong industrialization such as Europe and America.

On the social level, high electricity prices push people to take into account the energy consumption criterion. For example, according to the magazine science and life the use of an ecological light bulb offers an annual gain of electricity that reaches a level of more than 100 Euros compared to a standard bulb.

While choosing an electronic system, it is important to consult its technical information, specifically the estimation of its power consumption. Indeed, several magazines that deal with high technology make comparisons between different products in terms of power dissipation. These products are evaluated in terms of average electricity consumption per year in order to make the user aware about the importance of the power constraint. For instance, the magazine named the “Internaute High Tech” presented a comparative study between a Plasma TV and an LCD television in terms of electrical power. Another study concerning the use of computers has been shown. It is estimated that a family computer turned on 24 hours a day can increase the bill by 300 euros per year. Concerning mobile systems, their energy consumption has a greater effect. These systems are limited by the lifetime of their batteries. Thus, reduced power consumption leads to a certain increase in the operating time of these systems.

Reducing power consumption increases battery lifecycle and reduces its production and its storage. Such solution would produce less threatening mobile systems and be also imperative to emphasize the danger of batteries on the environment.

On the environmental side, ecological associations are worried about the influence and the effect of new information and communication technologies (ICTs) on greenhouse gas emissions. Unfortunately, the emergence of the Internet has turned mobility into a big enemy of the environment. Practically speaking, huge computing centers have been developed to store applications and data. These centers, which are mainly located in China and the United States, are powered by electricity produced from coal. According to the World Green Organization study “GreenPeace”, the impressive development of the Internet is the main responsible for the doubling of greenhouse gas emissions between 2007 and 2010.

Finally, Smart phones and laptops that have shaken the world of business and information influence the overall energy balance because of their power consumption. The reduction in the energy consumption of these systems will therefore make it possible to control existing primary energy and preserve the environment.

Concerning the second level, which is the technological one, power consumption has not only an impact on the environment, but also on the industry. In fact, the power consumption of electronic systems has an influence on their final cost and reliability.
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