ESTIMATION OF ENERGY CONSUMPTION IN EMBEDDED SYSTEMS

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Abstract—This paper presents an energy consumption model technique for embedded systems based on a PIC microcontroller (PIC16F877A). The software tasks that run on the embedded system are profiled and their characteristics are analyzed. The type of executed assembly instructions, as well as the number of accesses to the memory and the liquid crystal display, is the required information for the derivation of the proposed model. An appropriate instrumentation setup has been developed for measuring and modeling the energy consumption in the corresponding digital circuits.

Keywords—Energy consumption, PIC microcontroller, power estimation, embedded systems, energy consumption.

I. INTRODUCTION

Embedded systems play an important role in many areas of human life. Cellphones, PDAs, and satellites are only few examples of devices with a processor embedded in them. A large group of these systems are portable battery powered devices that have a limited source of energy. This makes the energy consumption a prominent characteristic. Hence, energy estimation during design phase of these applications helps designers in optimizing the energy consumption and the battery lifetime. Since software is responsible for a large portion of the system energy consumption, an accurate energy model is necessary for the system energy optimization.

In, there are two main models of embedded software energy estimation: measurement-based and simulation-based. In the simulation-based approach a simulation model of the target hardware is used to run the applications and calculate the energy consumption of each part of the system which may be as detailed as gate level or as abstract as behavioral level. This approach needs the simulation model of all hardware modules that are mostly unavailable or very expensive. Measurement-based methods use data obtained from a physical target device. Most of these models associate the instructions with the corresponding energy cost. The main advantage of measurement-based methods is high accuracy in the energy estimation due to the real values obtained from the target platform.

In this paper, we introduce a new instruction-level energy estimation model and tool for a microcontroller including the Processor core, RAM and ROM memories. This model includes only the energy of instructions and inter-instruction energy costs. Designing energy efficient hardware and software systems demand different tools at various level in the design hierarchy. Thus the estimation as to be done with compiler using various c programs. Instruction level parallelism is used here to estimate an accurate energy consumption in Flash memories. A PIC microcontroller (PIC16F877A) is programmed to read the data and to display the result on an LCD.

II. METHODOLOGY

A. System Overview

An ILP can highly enhance a program’s performance. This is used to perform the number of operations can be performed simultaneously. A compiler and processor designers is to identify and take advantage as much ILP as possible. There are two motors are used to run the program, but the motors does not able to receive the direct signal from the microcontroller. So, Motor driver is used for each DC Motors. The motor drivers are transistor and Relay, these are act as load. It is to control a circuit from low power signal. Mode of operation, it is to select operation which can execute at first. The photodiode does not pick up a purely AC signal as there are some DC components received from other. The varying resistance is converted in to a varying voltage by using a resistance network and power source. The device provides an accurate reading of the memory using optical technology. The signal (analog) originally was too small to detect, and without amplification proved in the addresses. After amplifying, the signal was fed to the comparator, resulting the output. The signal in the form of pulses is interfaced with microcontroller through its digital port for further processing. The Microcontroller is the heart of the circuit as in fig.1. The proposed work is done using PIC microcontroller.

The PIC Microcontroller (PIC16F877A) is programmed to acquire the signal using its embedded analog to digital converter (10-bit ADC), and use the readings to compute the heart rate; eventually, the heart rate is digitally displayed on an LCD (2X16 LCD). The data is sent to PC using serial port and thus analysis is done by using Proteus tool.
B. Hardware Description
The Microcontroller is the heart of the circuit as in fig.1. The proposed work is done using PIC microcontroller. The PIC Microcontroller (PIC16F877A) is programmed to acquire the signal using its embedded analog to digital converter (10-bit ADC), and use the readings to compute the heart rate; eventually, the heart rate is digitally displayed on an LCD (2X16 LCD). The two motor drivers are used before the DC motors. These motors are used to run the program, because the motor does not able to receive the direct signal from the microcontroller. So, Motor driver is used for each DC Motors. The motor drivers are transistor and Relay, these are act as load. It is to control a circuit from low power signal. Mode of operation, it is to select operation which can execute at first. The photodiode does not pick up a purely AC signal as there are some DC components received from other. The varying resistance is converted to a varying voltage by using a resistance network and power source. The device provides an accurate reading of the memory using optical technology. After amplifying, the signal was fed to the comparator, resulting the output. The signal in the form of pulses is interfaced with microcontroller through its digital port for further processing.

III. RESULTS AND DISCUSSIONS
The output of the motor was fed to one of the digital inputs of PIC 16F877A type microcontroller. Two functions is performed one is using pointers and another one is using macros. By comparing, both the results, estimation using macros is contain low memory consumption. The microcontroller output ports drive the LCD. Fig. 2 and 3 Shows the memory size of RAM and ROM in the LCD display.

CONCLUSION AND FUTURE WORK
This paper proposes a compiler level optimization technique on real-time embedded systems with instruction level parallelism. A processor that executes every instruction one after the other (i.e. a non-pipelined scalar architecture) may use processor resources inefficiently, potentially leading to poor performance. The performance can be improved by executing different sub-steps of sequential instructions simultaneously (this is pipelining), or even executing multiple instructions entirely simultaneously as in superscalar architectures. Further improvement can be achieved by executing instructions in an order different from the order they appear in the program; this is called out-of-order execution.

The future work of this project is to implementation in hardware by using scheduling in LIN protocol to obtain the best result.

REFERENCES

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