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ENERGY ESTIMATION OF SOFTWARE USING NI-LABVIEW

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ABSTRACT

Embedded system are used intensively in all spheres of life.Software energy in an embedded system is the energy consumed while running the software .As the embedded system is expected to execute the task repeatedly. For battery powered embedded applications;energy consumption estimation is very important.Power optimization need to be achieved at only at a hardware level,but also at software level.the power consumption minimization not only increase battery life but also reduce the heat generation in chip and other relevant issues.The result shows less than 19% error in energy consumption estimation.The instruction level energy estimation is used for Arm Cortex M4 processor results obtained are compared with micro benchmark programs.

Keywords: Current measurement,Energy Estimation,Software Power,NI-MYDAQ.

I.INTRODUCTION

Embedded systems are being used extensively in day to day life. They are used in variety of applications like cell phone, PDA, medical equipment etc. Many of the embedded applications are battery dependent i.e. they use battery as energy source. The total energy consumption of an embedded application is because of hardware and software. Energy consumption model of a processor software can be classified as low level models (hard ware models) and high level models. Different abstraction levels at low level models are: logic gate level, RT level and architectural level. High level models uses instructions and functional units from software perspective.

The simplified method for estimation of software energy for an Arm Cortex M4 processor based embedded system. The effect of immediate value in instruction affect the energy consumption.

The method of getting energy consumption data energy consumed can be calculated knowing the value of the current drawn by processor core,core voltage and time taken to execute the instruction.

II.RELATED WORK

The energy of an instruction is define as a some of three components.The pure base energy cost ,the inter-instruction cast. Energy consumed can be calculated knowing the value of current drawn by processor core, core voltage and time taken to execute the instruction. Methods in use are: measuring voltage across a precision

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resistor connected in core power line (average current), current mirror method or cycle accurate current monitoring using digital oscilloscope. More complex circuitry results in more accurate readings.

Base cost – It is the energy consumed while executing a particular instruction. This can be measured by placing the instruction in a loop so that a stable reading can be obtained. Small loop may result in error (due to branch effect) and a large loop may result in cache miss. Thus choosing loop size is very crucial.

Inter instruction cost – It is the energy consumed when executing two consecutive instructions. Say Instruction-1 base cost is 3 nJ and Instruction-2 base cost is 2 nJ. When Instruction 1 & 2 are executed, the energy consumed can be 5.5 nJ. This 0.5 nJ is due to inter instruction effect. It can be negative also. Lot of measurements to be carried out to check all combinations of Instruction set Architecture (ISA) and is given by n(n-1)/2. Where n is number of instructions in ISA. The different ordering of instructions result in different values i.e. it is not symmetric.

Energy sensitive factors - Apart from base cost and inter instruction cost, software power depends on certain factors like register number, register value, immediate value, operand value, operand address and fetch address.

III.PROPOSED APPROACH

In this paper, we present an accurate method for instruction level power estimation of ARM COREX M4 ,here the pure base cost of an instruction is measured.We use LPC54102 kit on this kit 32bit ARM-CORTEX M4 processor used, with three stage Harvard architecture with sample rate of is chosen for all measurement. Average current for a period of 1sec.is considered for energy calculation to find best cost, each instruction is executed thousand in a loop this minimize the effect of “BL LOOP” instruction on base cost. and also 8.2Ωresistor is connected at P2.

we estimated the energy by using two methods,one of them is NI LABVIEW and another is by using NXP software.

In NI LABVIEW by using MY-DAQ instrument to measure the voltage across a series 8.2Ω resister as shown in below FIG.1

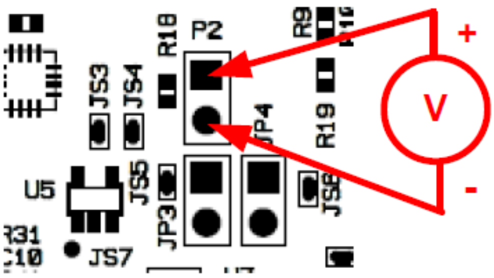


FIG.1Connection for voltage measurement

with the target LPC54102 VDD can be manually measured at P2 on the PCB the voltmeter positive probe is applied to P2 pin1 and negative probe to P2 pin2 above fig. use ohms law to calculate the current(LPC54102 current = measured voltage /8.2 Ω).

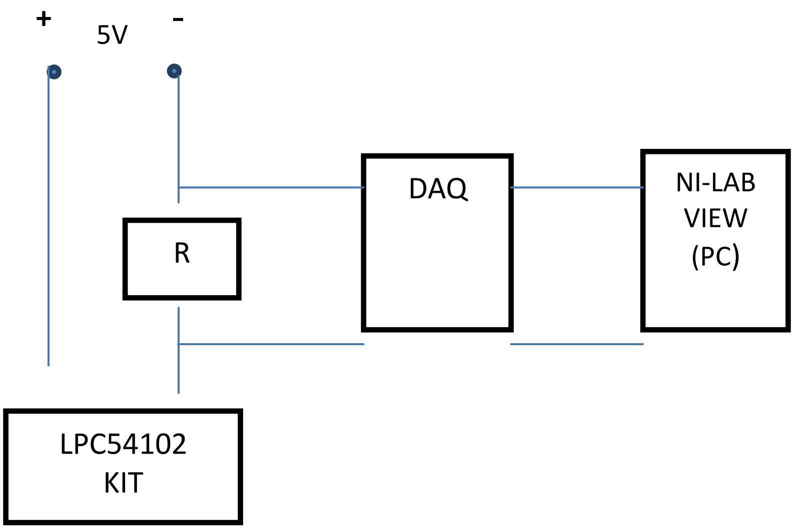


FIG2:Basic Block diagram of Proposed Model.

The basic model as shown in FIG.2 is that instructions are executed in repeated manner in processor and then current drawn by the processor is measured. After obtaining the current and the voltage magnitude power cost is estimated there are various techniques which are used in this paper for estimating power consumption of processor like using NI-myDAQ in order to get accurate measurement.

The average power consumed by microprocessor after executing a program is given by ,

$$P=V*I$$

Where,

V=supply voltage in volts

I=average current measured in amperes

Thus the energy consumption of program is given by,

$$E=P*T*N$$

Where ,

P=Power consumed by processor in watt

T=Clock period

N=Number of clock cycles taken by the

SAMPLE CALCULATIONS:

1.adc.w r7, r7, #0-

V=3.3V

I=3.162A

P=V*I

P=3.3*3.162

P =10.4346 mWatt

Energy,

E=P*N*T

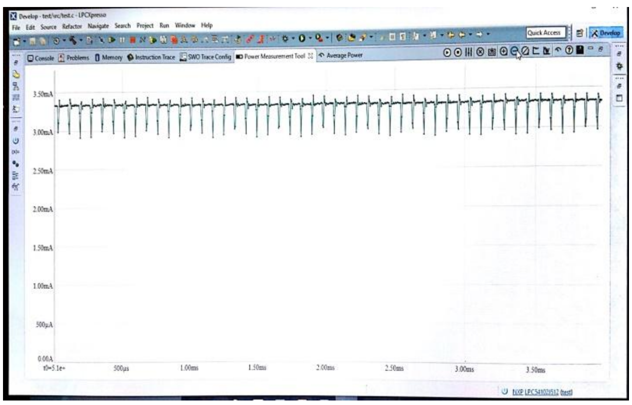
E =10.4346*1*0.0833

E =0.8692 nJ

IV.RUSULT

1. CURRENT WAVEFORM:

While measuring current taken to execute each microbench mark program. the below wavefrom observed during execution of microbench mark program.



2. .INSTRUCTION OUTPUT:

	TOTAL	AVG.
CURRENT (mA)	589221.931	2.524731901
VOLTAGES (V)	770097.9	3.3
POWER(mW)	1944439.949	8.331647738
CYCLES	369899	1.584964436
TIME(μsec)	19439.1379	0.0833
ENERGY(nJ)	249011.8367	1.06698019

3. PROGRAM OUTPUT:

	OUTPUT
CURRENT(mA)	2.605
VOLTAGE(v)	3.3
POWER(mW)	**8.8245**
CYCLES	**369899**
TIME(μsec)	**.0833**
ENERGY(nJ)	**254049.77**

4.PERCENTAGE ERROR:

Percentage error=(Estimated Energy-Actual Energy)/Actual Energy*100

Estimated Energy(nJ)	**Actual Energy(nJ)**	**Percentage Error(%)**
249011.8367	**254049.77**	**-1.9**

V. CONCLUSION

During our project work on “ENERGY ESTIMATION OF SOFTWARE USING NI-LAB VIEW”. the instruction level energy estimation can be achieved by monitoring average current of instruction. knowing the current the energy consumed can be calculated .This method has been applied to ARM Cortex M4 microprocessor based system .

we measure the various parameters like voltage,current .once we know this two parameters we can easily find out the energy consumed by instructions as well as software.

In this paper the percentage error between Estimated energy and Actual energy is -0.19% so this method is very effective for Energy Estimation.

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