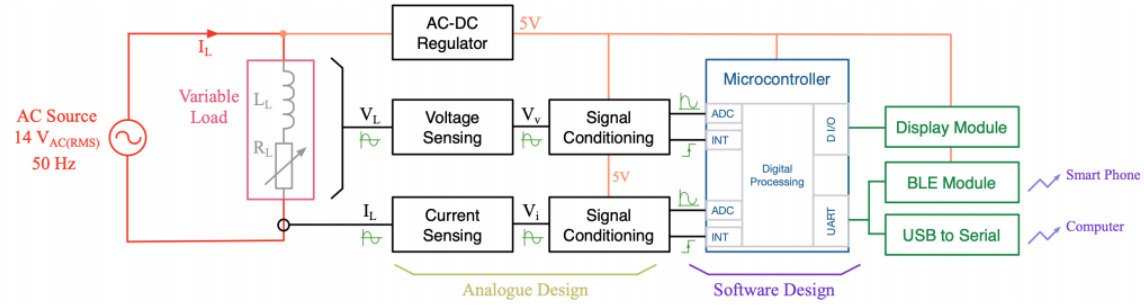
ENGGEN209 - Team 2 - Project Specifications:

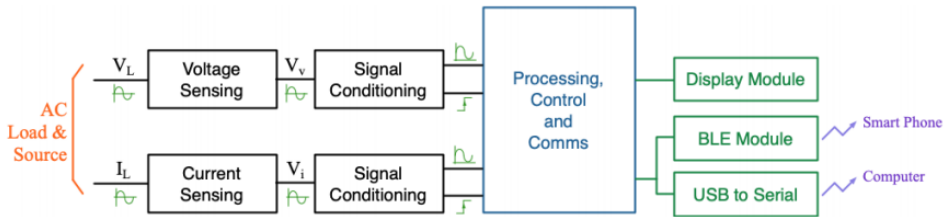
Overview Of System To Impliment:

System to Implement

- To simplify the design, we will consider a scaled-down system, which uses a low-voltage AC source
  - An AC load, consisting of a variable resistor in series with a fixed inductor, is used to emulate an house-hold appliance



How Does an Energy Monitor Work?



- To implement the core energy monitor functionalities we have to
  - Measure the load current and voltage
  - Process these measurements to calculate the power and energy used by the load
- To implement a suitable user interface we may need to
  - Control a display to show the voltage, current, power and energy measurements to the user(s)
  - Communicate these measurements wirelessly with smart devices
  - Communicate these measurements through serial with a computer

Key Design Specifications:

Key Design Specifications

Parameter	Value
Source Voltage	14 V_{RMS} ± 10%
Source Frequency	50 Hz ± 2%
Load Range	2.5 VA to 7.5 VA
Load Power Factor	0.75 to 0.99
Measurement Accuracy	5% of full-scale reading
ADC Conversion Rate	1 kHz or slower
LCD Display Information	Voltage, Current, Power and Energy
LCD Display Units	V_{RMS}, A_{pk}, W and W.min
LCD Scroll Rate	1 s
UART Baud Rate	9600 Baud
Information Transferred Via UART	Voltage, Current, Power and Energy
PCB Size	20000 mm²
PCB Technology	Double Layer with PTH
Device Technology	TH or SMT

Planner

Course Calendar

		Monday	Tuesday	Wednesday	Thursday	Friday
Wk 1	Jul	27	28	29 Lec – Intro *Wrk – Colab. Tools*	30	31 Lec – Sensors *Wrk – Colab. Tools*
Wk 2	Aug	03 *Lab – AC Circuits (S)*	04 *Lab – AC Circuits (S)*	05 Lec – Amplifiers *Lab – AC Circuits (S)*	06	07 Lec – Filters *Lab – AC Circuits (S)*
Wk 3	Aug	10 *Lab – AC Circuits (M)*	11 *Lab – AC Circuits (M)*	12 Lec – Regulators *Lab – Signal Con. (S)*	13	14 Lec – Micros *Lab – Signal Con. (S)*
Wk 4	Aug	17 *Lab – Signal Con. (M)*	18 *Lab – Signal Con. (M)*	19 Lec – UART *Lab – UART (S)*	20	21 Lec – ADC *Lab – UART (S)*
Wk 5	Aug	24 *Lab – UART (M)*	25 *Lab – UART (M)*	26 Lec – Conversion *Lab – Support*	27 **Test 1**	28 Lec – Prototyping *Lab – Support*
Wk 6	Aug/Sep	31 **Progress Review**	01 **Progress Review**	02 Lec – Components *Wrk – Altium*	03	04 Industry Seminar *Wrk – Altium*
	Sep	07	08 *Lab – Support*	09	10 *Lab – Support*	11
	Sep	14	15 *Lab – Support*	16	17	18 *Lab – Support*
Wk 7	Sep	21 *Lab – Support*	22 *Lab – Support*	23 Lec – Interrupts *Lab – ADC (S)*	24 **PCB Submission**	25 Lec – Timers *Lab – ADC (S)*
Wk 8	Sep/Oct	28 *Lab – ADC (M)*	29 *Lab – ADC (M)*	30 Lec – Instruments *Lab – Timers (S)*	01	02 Lec – Q&A *Lab – Timers (S)*
Wk 9	Oct	05 *Lab – Timers (M)*	06 *Lab – Timers (M)*	07 *Lab – Displays (S)*	08	09 *Lab – Displays (S)*
Wk 10	Oct	12 *Lab – Displays (M)*	13 *Lab – Displays (M)*	14 *Lab – Support*	15 **Test 2**	16 *Lab – Support*
Wk 11	Oct	19 *Lab – Support*	20 *Lab – Support*	21 *Lab – Support*	22	23 *Lab – Support*
Wk 12	Oct	26 **Labour Day**	27 **Interviews**	28 **Interviews**	29 **Interviews**	30 Rap Lecture

Circuitry to sense the voltage and current supplied to the load:

- Signal conditioning circuitry to amplify and filter the sensed voltage and current signals.
- A software-based digital processing system, which uses an ATmega328P microcontroller, to convert the analogue signals provided by the signal conditioning circuit to digital form and calculate the voltage, current, power and energy.
- AC to DC regulator circuitry to generate a 5 V DC supply for the analogue (and digital) circuitry employed in the energy monitor.
- A 7-segment LCD display module, which is connected to the microcontroller via a shift-register, to show the calculated information.
- A Bluetooth LE module, which is connected to the microcontroller via Universal Asynchronous Receiver/Transmitter (UART), to communicate information with a smart device like a phone.
- A USB interface with serial emulation, which is connected to the microcontroller via UART, to communicate information with a laptop/PC.

Provided Items

- The source configuration circuit.
- An Xplained Mini 328PB microcontroller module with headers providing easy access to the ports
- An HM-10 Bluetooth LE module which contains a CC2540 system-on-chip (SoC) and associated circuitry needed to interface directly with the UART port of the microcontroller
- A 4-digit seven-segment LCD display module which contains a 74HC595 shift-register and the logic circuitry required to interface with digital IO pins of the microcontroller.