ELECTRONIC ENERGY METER
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1. Background
• An energy monitoring device to help those environmental-friendly or any consumer to keep tracks of their energy usage and how much should they pay for it.
• Compatible with BS 1363 standard plug [1] - to be marketed in Malaysia (but suitable for UK market too).

2. Goal
1. To build a cheap and clear energy meter for consumer.
2. To gain a Class 1 accuracy based on IEC62053-21.
3. To select a suitable chip and demonstration board.

3. Finished Product
• Voltage sensor: 240/9V adaptor (provided).
• Current sensor: Hall effect current sensor (provided).
• Micro-controller board: Arduino Due (£32.29).
• Display: FDCC1602G 16x2 LCD module (£8.77).
• Calculation [3]:
  \[ \text{Average power} = \sqrt{2} \cdot \text{Irms} \cdot \text{Vrms} \]
  \[ \text{Irms} = \sqrt{\frac{1}{T} \int_i^j i^2 \, dt} \]
  \[ \text{Vrms} = \sqrt{\frac{1}{T} \int_i^j v^2 \, dt} \]
  \[ \text{energy} = \text{Average power} \times \text{time} \, (\text{kWh}) \]
  \[ \text{cost} = \text{energy} \times \text{tariff} \]
• Malaysia’s energy supplier tariff is 21.8 cent/kWh for the first 200kWh consumption per month [4].
• Product tested using a 150W light bulb.

4. Challenges
• The resultant accuracy = \( \frac{150.0 - 147.7}{150.0} \times 100\% = 1.5\% \)
• ADC used is 10-bits.
• The product has no protective case-susceptible to damage.

5. Future Development
• Use 12-bits ADC (available on Arduino Due).
• Add interfacing buttons for user to key-in the tariff value in case of change in tariffs rate.
• Develop a casing to protect the circuit and user.

6. Conclusion
The goals of the project are achieved. A cheap and clear energy meter has been successfully built, using Arduino Due which is based on AT91SAM3X8E[5] and a 16x2 LCD for demonstration. However the accuracy of the product should be improved as it fails to obtain 1% accuracy. Currently the accuracy of the energy meter is 1.5%.

Reference: