“Low–Cost Non–Intrusive Residential Energy Monitoring System”

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Introduction

- As of 2013 more than 350 million people do not have access to electricity - 56.5% rural households remain unelectrified - in India

- Need for energy efficiency - energy conserved is energy generated

- A typical urban household consumes 900 KW/Year – 96 KW/Year in rural

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Problem Statement

- Energy access is limited in rural areas
- Existing systems are expensive, sophisticated and intrusive
- Not suitable for rural/low income urban scenario
- Need for low - cost affordable system for target customers

System Design constraints

- Low cost
- Open source
- Off-the shelf sensors
- Mass production
- Easy maintenance

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Assumptions

- Very few basic loads
- Number of loads are more are less fixed with not more than one variable load.

Methodology

- Device Identification
- Non – Intrusive current sensing

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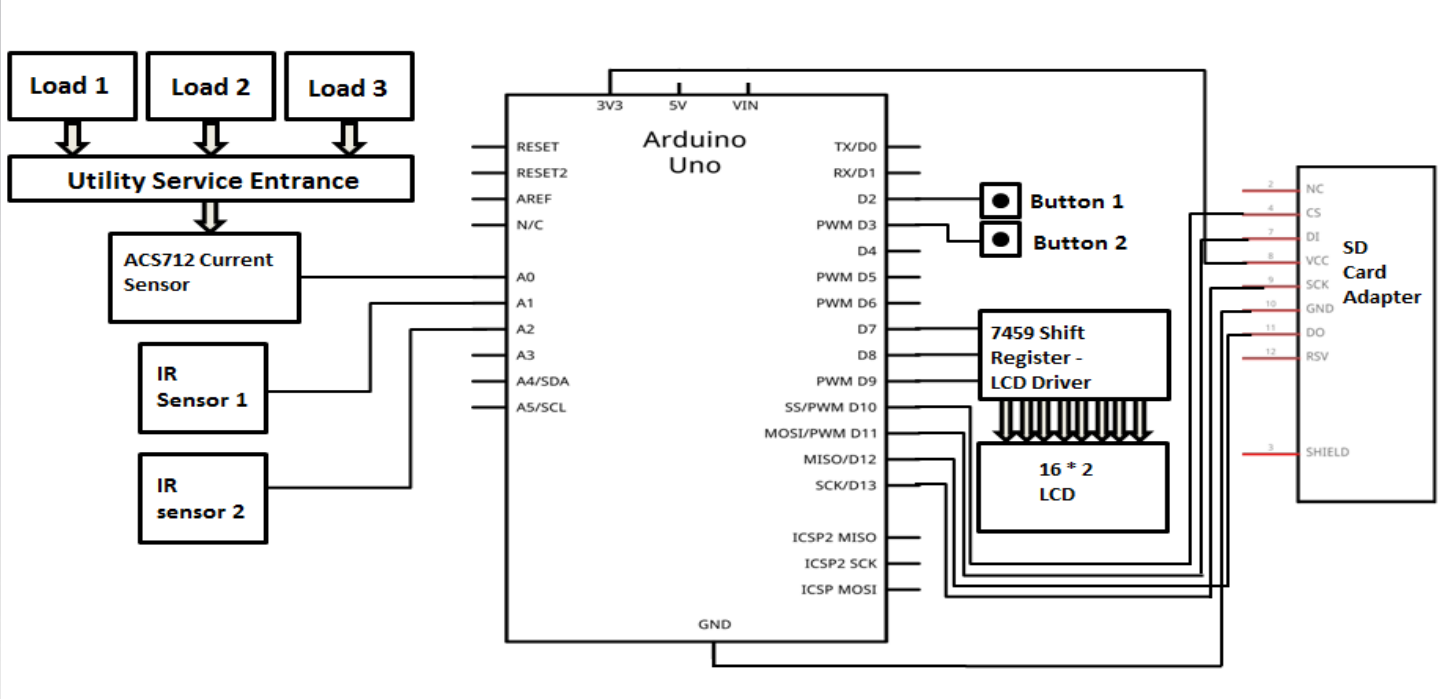
System Block diagram



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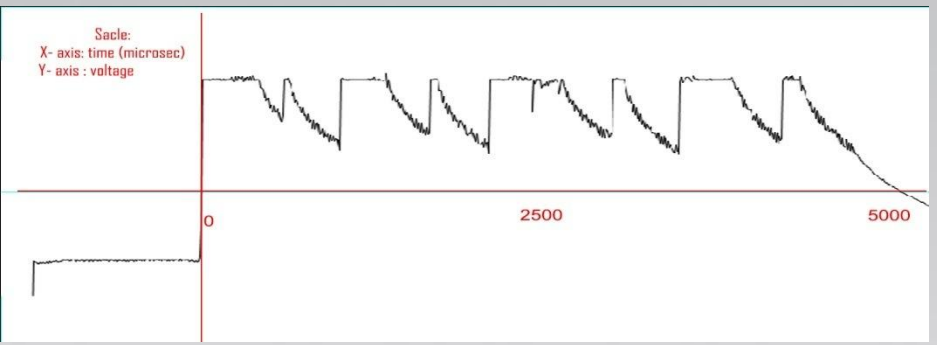
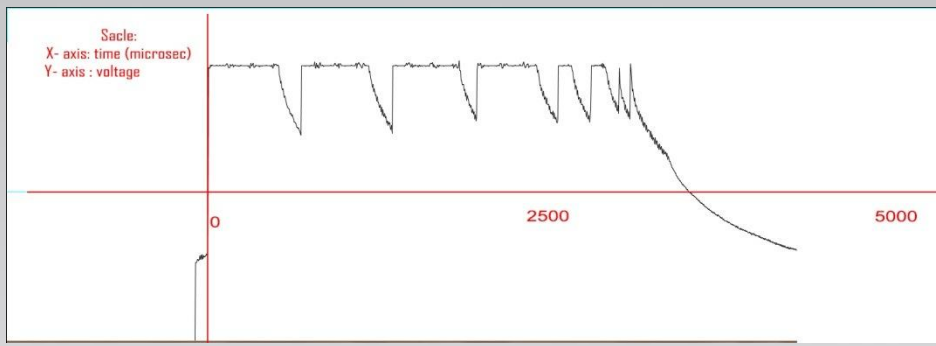
Phase one: Installation and Training

- Training process is initiated to obtain load parameters.
- Current pattern of different combination of loads are measured and recorded in a look up table.
- The Look up table serves as a reference for device identification during runtime.

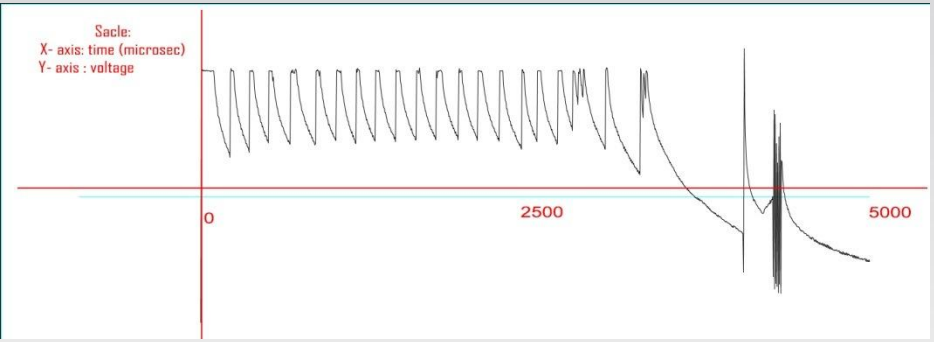
Current patterns



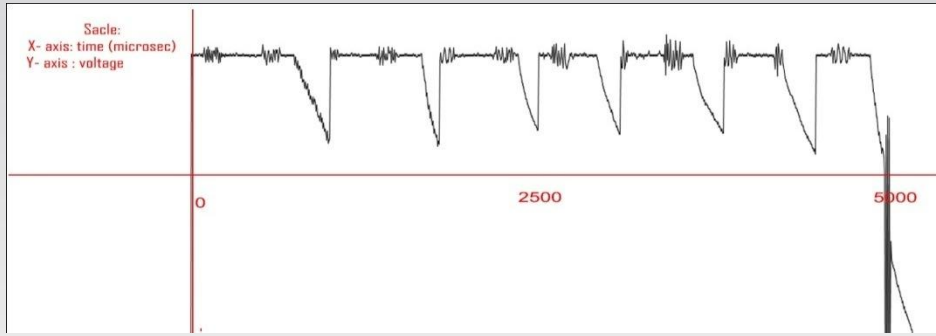
Device 1



Device 2



Device 3



Device 1&2

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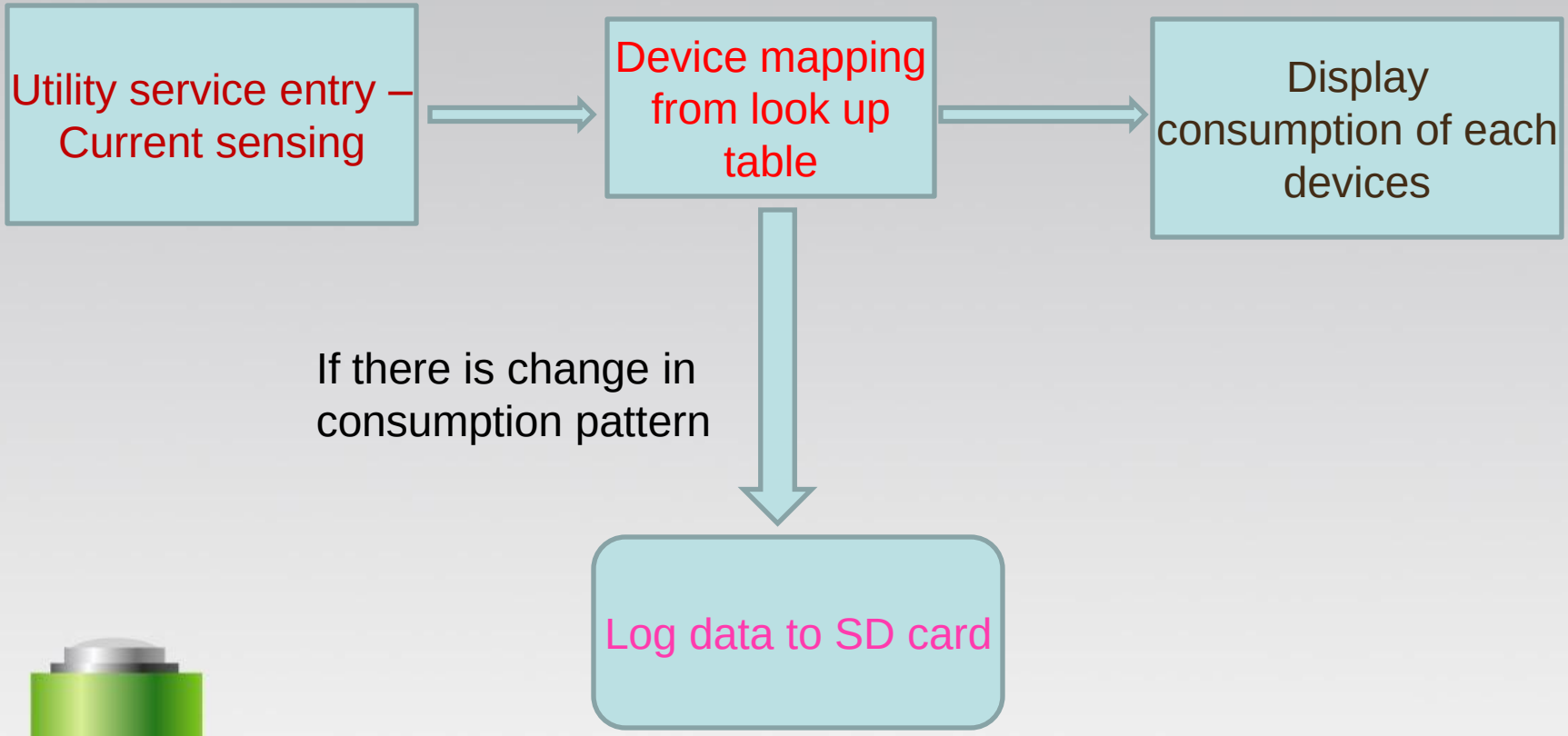
Look up table

Name of the Device	I average
Device 1	4.78
Device 2	3.28
Device 3	4.01
Device 12	4.21
Device 13	4.54
Device 23	3.95
Device123	4.66

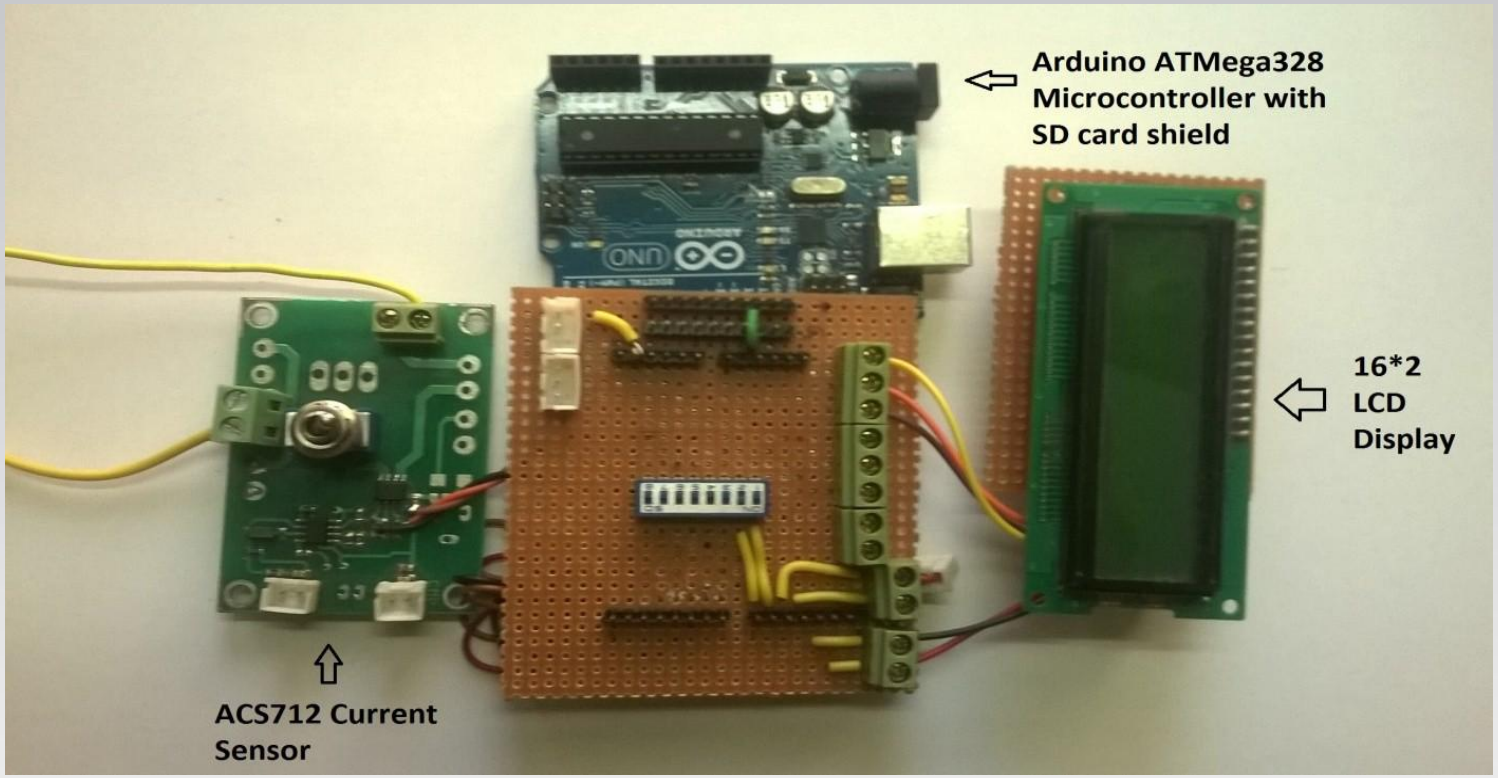
Phase two : During runtime

- Continuous current sensing at utility service entry
- Mapping the sensed device value - look up table
- Closest match is found
- Change in consumption - Data is logged
- Display – user consumption

Run time Flow chart



Proof of Concept



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Device Ratings

Device	Type Of Load	Power Rating	Voltage Rating	Current Rating
Device 1	Resistive	35 watts	220 V	0.15 A
Device 2	Resistive	20 watts	220 V	0.09 A
Device 3	Inductive	11 watts	220 V	0.05 A

Sample Data Log Table

Time Stamp	I average
09 03 2014 12:04:44 PM	4.01 A
09 03 2014 12:08:01 PM	3.28 A
09 03 2014 12:12:45 PM	4.66 A
09 03 2014 12:15:45 PM	3.95 A

Conclusion

- Optimize consumption
- Savings/additional usage
- Utility service provider – learn user behavior
- Dynamic pricing mechanisms

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Thank you

Questions