**POSTER ID- AR01**

# Development of a Smart Controller to Optimize Air-Conditioners Energy Use

Shubham Shantanu Kulkarni
Electronics & Telecomm. Engineering, Government College of Engineering,Karad
Dr E. Rajasekar, Assistant Professor, Architecture & Planning, IIT Roorkee

## MOTIVATION

- Household electricity demand is increasing very rapidly in emerging economies like India.
- AC is major contributor due to rising incomes, urbanization, hot climate and falling prices.
- By 2030, to meet this demand requires construction of nearly 300 new coal fired power plants of 500 MW each.
- Thus it is essential to find new ways of energy conservation.

## PROBLEM STATEMENT

We are developing a smart controller which will sense indoor & outdoor climate patterns and through Artificial Intelligence model it will modulate the operation of AC. Without affecting the thermal comfort of user, it will encourage user for energy conservation.

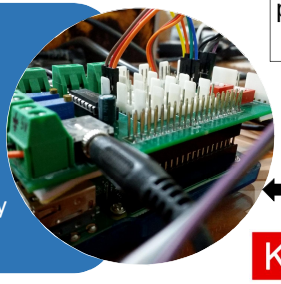
## METHODOLOGY

We are developing smart controller on Raspberry Pi platform.

The Raspberry Pi is a low cost, credit-card sized computer that plugs into a display, and uses a standard keyboard and mouse.


We are employing an interface board designed and developed by **NETZED laboratory** with facility of interfacing sensors, energy meter, and other connection requirements.
It will measure indoor, outdoor climate parameters, attached with Raspberry Pi.

Sensors -
1.Temperature (Indoor & Outdoor)
2. Pressure
3. Humidity
4. Light Intensity
5. $CO_2$ Level



ARTIFICIAL intelligence

Keras pandas

Node-RED

scikit learn

TensorFlow

### PROGRAMMING

We have developed programs that will record above climate conditions.

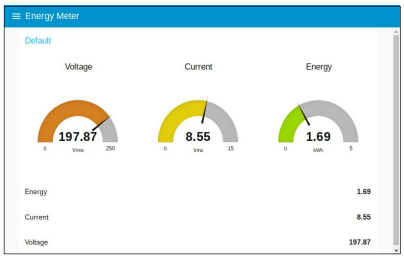
Energy meter attached with AC will monitor real time energy consumption in kWh & will be displayed to user with NODE-RED platform.

### ARTIFICIAL INTELLIGENCE

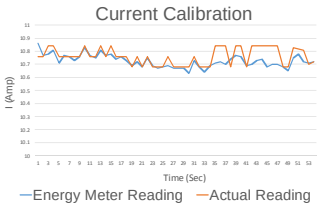
- ✓ Powered by artificial intelligence algorithm developed with Deep Neural Network and Tensorflow.
- ✓ **Back-propagation algorithm** technique looks for the minimum value of the error function in weight space using a technique called the delta rule.
- ✓ Continuous study of users behaviour with periodic training. It will modify database leading to more accurate predictions.

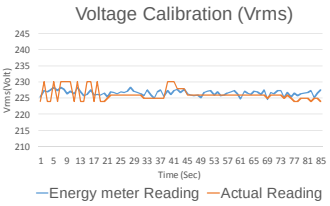
## OUTCOME

Interfacing of sensors to prototype is completed.




Energy Meter will be displayed by our prototype.
Calibration with commercial energy meter is shown in the following graphs-




### Artificial Intelligence Development & Outcome

Deep Neural Networks is a field of study that gives computers the ability to learn without being explicitly programmed.

1. Prototype will predict about energy consumption based on users behavior, time, indoor & outdoor climate.
2. It will be used to calculate future energy requirements.
3. To optimize energy consumption it will display messages to user. Like if outside temperature is low then user will be suggested to open windows & AC will turn OFF.

DEEP LEARNING

Our prototype is in developing stage in terms of artificial intelligence-

1. Further we will develop operative modes where user will be encouraged to choose ECO mode. This mode will save energy without affecting the thermal comfort. User can choose modes by a dashboard displayed on screen.

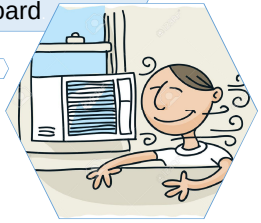
## CONCLUSION

✓ **We are expecting about 15-20% of energy saving.**

## SUMMARY

Artificial Intelligence will predict about energy consumption powered with energy meter & dashboard

Smart controller will encourage user for energy saving by displaying messages and without affecting thermal comfort.



## FUTURE OUTLOOK

We are looking for casting this as a product
Development of prototype focuses on Commercialization

*Credits* ï Kapil Sinha, Subramanian G - NETZED Laboratory

**References:**

**1.** BME 280 SPI Interface in Python. (n.d.). Retrieved from https://www.raspberrypi.org/forums/viewtopic.php?t=149528 **2.** Brownlee, J. (2019). *Deep Learning Model*. Retrieved from https://machinelearningmastery.com
**3.** Geoffrey Hinton, U. (n.d.). *Neural Networks for Machine Learning [FULL COURSE]*. Retrieved from Youtube: https://www.youtube.com/watch?v=6cHupvcxA38&list=PLLssT5z_DsK_gyrQ_biidwvPYCRNGI3iv&index=6
**4.** *Github, INC [US]*. (n.d.). Retrieved from https://github.com/keras-team/keras/tree/master/docs **5.** *Keras Documentation*. (n.d.). Retrieved from Keras: The Python Deep Learning library: https://keras.io/models/sequential
**5.** *Python & CircuitPython Test*. (n.d.). Retrieved from https://learn.adafruit.com **6.** *stackoverflow*. (2019). Retrieved from Stack Exchange Inc: https://stackoverflow.com/questions **7.** *TensorFlow Certification Training*. (2019). Retrieved