



The poster for the India Innovation Challenge Design Contest 2019 (IICDC 2019) features a central image of three students (two men and one woman) working together on a project involving a breadboard and electronic components. The text on the poster includes:

- Logos at the top:** AICTE, DST (Department of Science and Technology), TEXAS INSTRUMENTS, IIMB (Institute of Management Baruch), NSRCEL, and myGov.
- Text on the left:** "DST & Texas Instruments", "INDIA INNOVATION CHALLENGE DESIGN CONTEST 2019", and "Anchored by NSRCEL @ IIMB".
- Text on the right:** "Powered by AICTE mission", "ENGINEER" (in large red letters), "Your ideas into INNOVATION", "Your dreams into a START-UP", "The future of INDIA", and "Registration Date extended until Sep 30th".
- Prizes at the bottom:**
 - 1 CHANCE TO WIN
 - 2 Cr seed fund to top 10 startups
 - 1.44 Cr stipend for incubates
 - 70 Lacs worth of free TI Tools
 - 50 Lacs cash prizes (400+ types)
 - 25,000+ certificates spread across the contest
 - 1.5 Cr product development funds for top 30 teams

IICDC 2019 PROPOSAL

Team ID :1330083

College Name :DHAANISH AHMED INSTITUTE OF TECHNOLOGY

SOLUTION FOR DISCRETE POWER MANAGEMENT AND HOOK UP POWER THEFT



Table of Content

1.0 Team Details

- a. Team Establishment
- b. Team Members – Roles & Responsibilities
- c. Faculty Authorization Letter
- d. Faculty Assessment Letter
- e. E-Cell Assessment Letter

2.0 Business Details

- a. Project Abstract
- b. Market Analysis

3.0 Technical Details

- a. Product Brief
- b. Proposed Design
- c. Innovativeness of the Proposed Solution
- d. Impact of the proposed solution
- e. TI Components Used
- f. NON-TI Components Used



1.0 Team Details

a. Team Establishment.

Team Leader:

MUHAMMED SHIBILI K

BE ELECTRONICS AND COMUNICATION (3rd semester)

Team members:

FAHAD M T

BE ELECTRONICS AND COMUNICATION (7^{nth} semester)

AMEER ZAIN S

BE ELECTRONICS AND COMUNICATION (3rd semester)

MISBA KAUNAIN

BE ELECTRONICS AND COMUNICATION (3rd semester)

MUHAMMED SHIFAS

BE ELECTRONICS AND COMUNICATION (3rd semester)

NOOR MOHAMED SHA

BE ELECTRONICS AND COMUNICATION (3rd semester)

Faculty Mentor:

A NANDAKUMAR

ASSISTANT PROFESSOR

DEPARTMENT OF ELECTRONICS AND COMMUNICATION



India Innovation Challenge Design Contest 2019

b. Team Members – Roles & Responsibilities

MUHAMMED SHIBILI K
Designing and Programming

FAHAD MT
Simulation and CAD designing



AMEER ZAIN S
Power measurement infrastructure

NOOR MOHAMED SHA
Hooking and Tampering detection

MISBA KAUNAIN
GSM and cloud data analysis

MUHAMMED SHIFAS
Product marketing

c. Faculty Authorization Letter

	Dhaanish Ahmed Institute of Technology Coimbatore - 641107 Approved by AICTE, New Delhi and Affiliated to Anna University	
---	---	---

Authorization Certificate


From : 29.10.2019

A.NANDHAKUMAR
AP/ECE
DHAANISH AHMED INSTITUTE OF TECHNOLOGY
COIMBATORE 641105
9629511733

Dear Sir,

This is to certify that A.NANDHAKUMAR will authorize to mentor the 1330083 comprising of the Muhammed Shibili K, Muhammed Shifas, Fahad M T, Ameer Zain, Misba Kaunain, Noor Mohamed Sha in the IICDC 2019 contest.

If the team is shortlisted for the Quarterfinals Phase Round, I agree to receive the TI tools worth 200 \$ and drive the teams to submit the Prototypes.





With Regards

A.Nandhakumar

Assistant Professor/ECE



d. Faculty Assessment Letter

	Dhaanish Ahmed Institute of Technology Coimbatore - 641107 Approved by AICTE, New Delhi and Affiliated to Anna University	
---	---	---

FACULTY ASSESSEMENT LETTER

29.10.2019

From :

A.NANDHAKUMAR
AP/ECE
DHAANISH AHMED INSTITUTE OF TECHNOLOGY
COIMBATORE 641105
9629511733

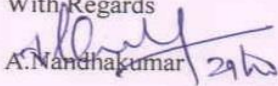
Dear IICDC-Coordinator,

This is to certify that 1330083 participating in the IICDC 2019 have submitted their Idea Proposal under the leadership of MUHAMMED SHIBILI K has been verified by me and approved

Following are my observations about the Proposed Idea:

The team is working hard on a unique way of power grid theft protection system that can revolutionize our electricity distribution. The power theft is the biggest challenge that threatens our national growth and causes great losses in our economy. Power line hookups are very easy and currently, we have no equipment to locate this illegal activity. In the Indian scenario, these hook lines are the major theft method and these activities pull our economy down to the dept. Their idea tackles this hard issue with smart solutions at a reasonable cost. But its benefits are twice than its cost since it evaluates the transmission losses and enables Pre-or-post subscriptions and Time-of-use-tariff.

With Regards




A. Nandhakumar

Assistant Professor/ECE



India Innovation Challenge Design Contest 2019

e. E-Cell Assessment Letter

	Dhaanish Ahmed Institute of Technology Coimbatore - 641107 Approved by AICTE, New Delhi and Affiliated to Anna University	
---	---	---

E CELL ASSESEMENT LETTER

From :

29.10.2019

R PRAKASH
E CELL INCHARGE
DHAANISH AHMED INSTITUTE OF TECHNOLOGY
COIMBATORE 641105
8056345283

Dear IICDC-Coordinator,

This is to certify that 1330083 participating in the IICDC 2019 have submitted their Idea Proposal under the leadership of MUHAMMED SHIBILI K has been verified by me and approved

Following are my observations about the Proposed Idea:

INDIVIDUAL POWER MANAGEMENT is an emerging need of electricity consumers and also it is an unavoidable procedure of energy-saving strategy in upcoming years. The idea deserves high economical impact since its solidly innovative and makes our life easier. By monitoring each device, the user can easily analyse which appliance is consuming his pocket and which is honestly efficient to their rating. Visiting for billing and power disconnection procedures are not economical especially in hard to reach geographical areas. Here these students introducing a cloud-based power grid in which even the power can be disconnected remotely. Time-of-use-tariff is helpful to both consumers and distributors since it enables the user to run his high power appliances at off-peak periods on low tariff and the distributors can maintain the energy demand at peak periods.

With Regards



Prakash
29/10/19.
R. PRAKASH.



India Innovation Challenge Design Contest 2019



2.0 Business Details

a. Project Abstract

Global electricity demand will reach around 38,700 terawatt-hours by 2050. The exponential growth of electrical loads such as electric cooking, electric vehicles and air-conditioners will lead to tremendous energy demand in coming years. Online energy monitoring of each appliance or department has become more unavoidable procedure for energy-saving strategies. Here, we are forwarding the cloud-based DISCRETE E-METER which can track up to 16 individual departments power consumption along with mains. The user can easily analyze the devices and make the energy plan with usage limits.

The rise in the electricity tariff will also lead to more illegal theft in power lines. These illegal connections are hard to control since power line hook ups are difficult to locate in urban areas. To locate these hook lines, we designed the DISTRIBUTION MONITORING METERS to install on distribution transformer. These MONITORING METERS compare the total consumed power with losses and reports if the theft event has occurred.

b. Market Analysis

SCENARIO 1

Global total energy consumption grew by 2.3% in 2018, twice as fast as the average rate over the last ten years. Electric loads are increasing exponentially due to the migration from expensive and insufficient fossil fuels to a single source of electricity. Domestic energy demand is rising because of the increasing number of electric appliances and further on the electric-vehicles. The power tariff also began to grow with demand. Spot power tariffs witnessed a sharp increase in September 2018 with the average rate to Rs 4.7 per unit from Rs 3.3 in August 2018. (source: internet)

Cloud-based power consumption monitoring of each device or department have become more unavoidable procedure for energy-saving strategies for the consumers. Even though the only solution to handle this demand, is the individual usage analysis and power planning, the electricity meters in the market doesn't provide these features.

SCENARIO 2

The. Non-technical losses mainly arise due to transmission losses and power theft. The rise in electricity tariff will also lead to more illegal theft in power lines which is a great challenge to the nation. According to the World Bank estimates, power theft reduces India's GDP by around 1.5% and the Indian power sector loses around \$16.2 billion to theft every year. Mumbai – alone loses \$2.8 billion per year (source: internet), more than all but eight countries in the world. This illegal power usage is hard to control since most of the power lines in India is not insulated and power line hooks up are very simple and difficult to locate in urban areas. The hookup and meter tampering are the major challenge faced by distribution boards in India and prevention is the only solutions to survive from the dept.



CUSTOMER'S BENEFITS

Our customers are the state electricity boards and the private electricity distributors over the country. By installing the CLOUD-BASED E-METERS and DISTRIBUTION MONITORING METERS progressively replacing the existing meters, what benefits they can expect.

✓ Billing and Collection efficiency:

GSM E-METER ensures accurate and inexpensive billing with pre-paid or post-paid subscriptions from state distribution boards, and also the authorities can remotely disconnect or reconnect customers who fail to pay bills on time. It is an expensive method to visit each consumer for billing and disconnecting procedures especially countries like India consisting of various terrains, where hard to reach. Automatic billing helps distribution boards to reduce technical and commercial losses from around 30% to 17% since the human effort is reduced on a large scale.

✓ Power Theft control and loss analysis

Electricity theft is the hardest challenge faced by the electricity boards in India pulling down to the depths. As mentioned before, it reduces the national GDP, losing billions due to lack of education or some anti-national selfish persons and industries. By minimizing this huge loss with DISTRIBUTION MONITORING METERS is highly efficient and economical when compared to the annual theft losses throughout the nation. It compares the sum of total energy consumption of connections with net distributed power by considering the losses, also this method enables the distributors to calculate and trace transmission losses and faults in the line.

✓ Time-of-use-tariff

GSM E-meters can also be used for time-of-use tariffs, that is tariff value varies up to the usage time. so that the consumers will reduce the power usage on high demand periods such as 6 pm to 9 pm. This allows distributors to create relatively low-price tariffs on 'off-peak' periods and encouraging the consumers to use high power appliances up to the 'Demand rate'. Thereby enabling distributors to take control of the voltage variations on the high demand periods.

CONSUMER'S BENEFITS

The domestic and industrial consumers are reserved to get more benefits by installing the GSM E- METER.

✓ Analyzing usage of individual devices

Present domestic power meters even smart meters are meant to measure only the mains current and it doesn't provide any clues of which device is consuming the great number on the meter reading. Further, it is a hard job to compute the bill amount from the meter reading for a common consumer. Monitoring of each department has become unavoidable procedure to reduce the electricity bill since the power tariff increasing day by day. The user can analyze the individual device usage from plotted graphs in the cloud spreadsheet.

✓ Pre-or-post subscriptions and Time-of-use-tariff

The user will get alerts if his subscription is ended or reached set limits and billing become easy. User can set device limits and prepaid planning on server page. The Time-of-use-tariff enables the consumer to reduce the amount by adjusting the usage to the Peak off time and deserved users get a reduced bill amount.



3.0 Technical Details

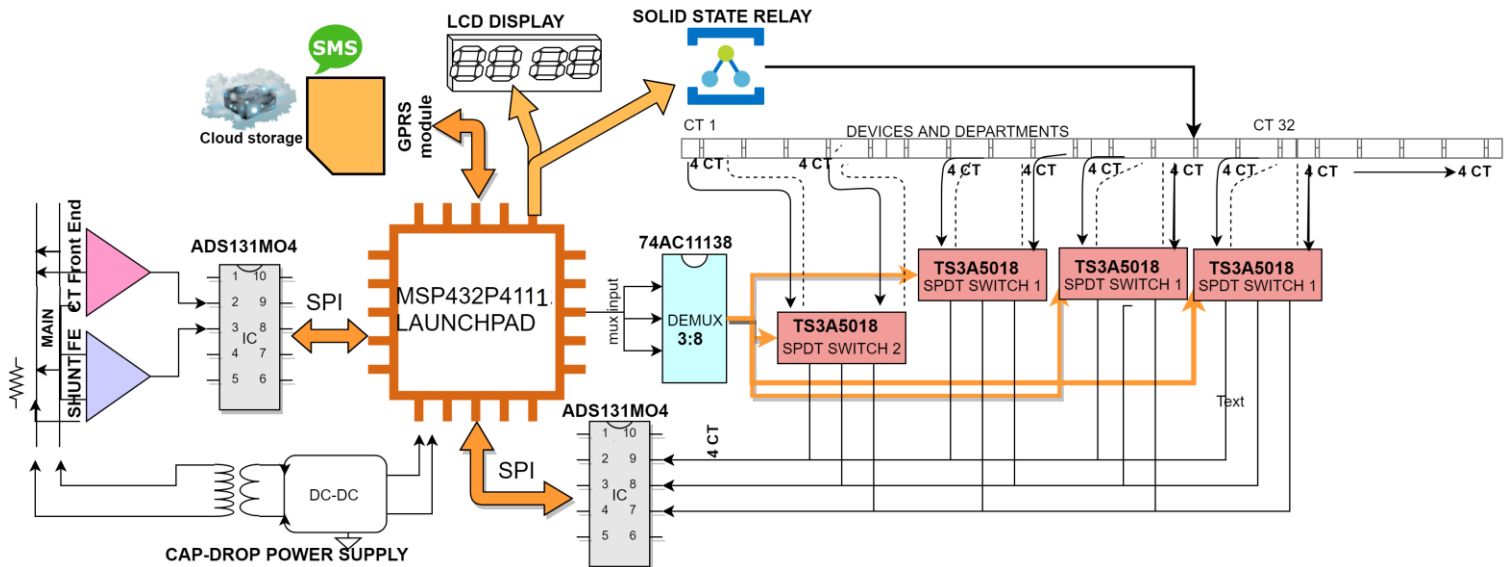
a. Product Brief

We designed a DECODER-SWITCHING SECTION to trace current drawn by each appliance or department by introducing current transformers. The mains current and voltages are measured using ADS131M04 24-bit delta-sigma ADC through the front-end circuit and values transferred to MSP-EXP416P4111 via SPI. Utilizing the measured mains voltage and CT values individual device power consumption is calculated and then saved into an array. On a specified interval of time, the array values uploaded to the Central server through GSM/GPRS module. From these values, the DISTRIBUTION MONITORING METER (installed at area transformer) evaluates the actual current drawn by loads and supplied power to estimate the amount of loss and theft. If any theft event has identified, the MONITORING METER will send an SMS alert to the distributor.

RTC of MSP-EXP416P4111 will keep track of the time for Tariff update and uploading the values. The device power usage limit can be set by the user in server window, according to usage limit the GSM module sends SMS alert to the subscriber.

b. Proposed Design

➤ Block Diagram for discrete monitoring E-METER



DECODER-CT-SWITCHING BLOCK:

The Decoder-CT-Switching block consists of three major components,

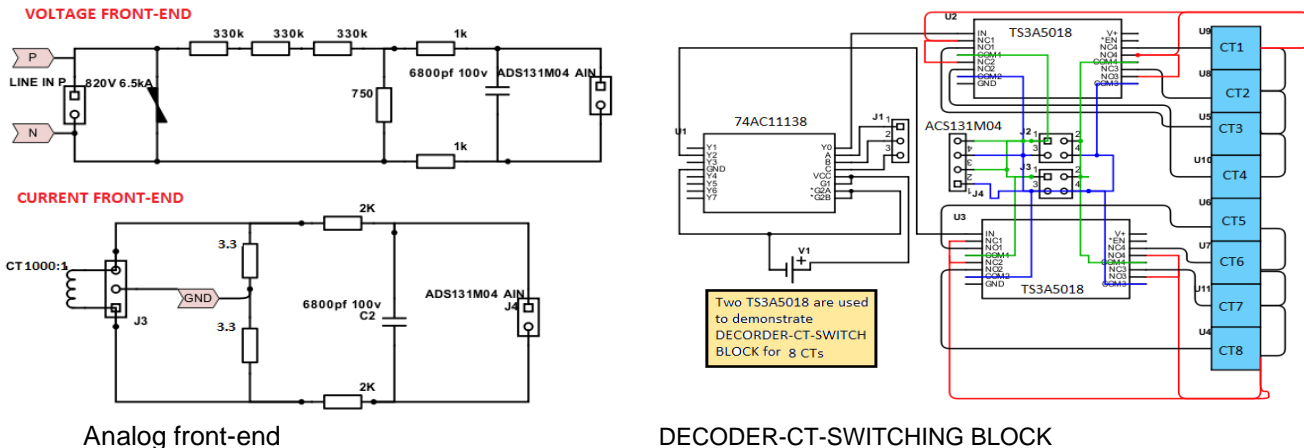
- 74AC11138:** The 3-line to 8-line demux/decoder IC available as P-DIP package. Only 3 output pins are needed for 16 device switching. By using the 4-lines, 32 appliances.
- TS3A5018:** This is a Quad SPDT Analog Switch which has 4 N/C and 4 N/O pins considered as CT input and common switch output connected to ADS131M04.
- CURRENT TRANSFORMER:** CTs, are transformers used to step down the high current level to measurable current levels. From CT ratio (1000:1) the actual current can be calculated.

For DECODER BLOCK CIRCUIT DIAGRAM [click here](#)

ANALOG FRONT-END:

The Voltage and Current Front-End is the intermediate block between power line and ADC which scale down the current and voltage levels measurable by ADC. Our current and voltage front circuits are inspired from TIDA-010036 references designs and 1-phase shunt electricity meters training videos. But instead of costly 2000:1 CTs we preferred low-cost 1000:1 and modified the front-circuitry with standard resistors.

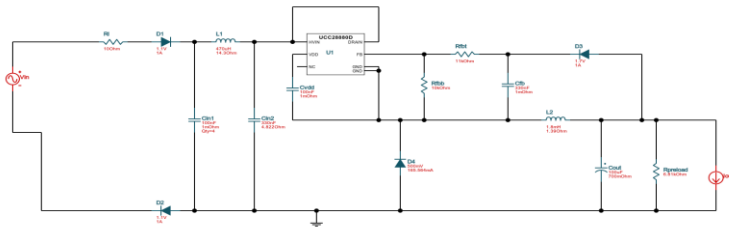
For CURRENT AND VOLTAGE FRONT-END CIRCUIT [click here](#)



Analog front-end
POWER SUPPLY:

The power supply for E-Meters must be immune to high magnetic field even though we are not included the hall magnetic tamper detection in this model because it exists in many E-Meters today. Since Buck power supplies are efficient and comparatively immune to the magnetic field we chose UCC28880DR - 120V-415V to 3.3V @ 0.05A buck design from Webench Power Designer.

UCC28880D WEBENCH SCHEMATIC [click here](#)



FUNCTIONAL ALGORITHM:

The E-METER uploads the metrology data to the server and the DISTRIBUTION MONITORING METER evaluates the losses from those data. To demonstrate the central server, we use THINGSPEAK Cloud Storage. ThingSpeak is an IoT analytics platform service that allows aggregate, visualize, and analyze live data streams in the cloud. Also, it can create instant visualization of live data, and send alerts. Thus, it is a suitable platform to demonstrate the central server.

For the demonstration of data uploading and evaluation E-METER

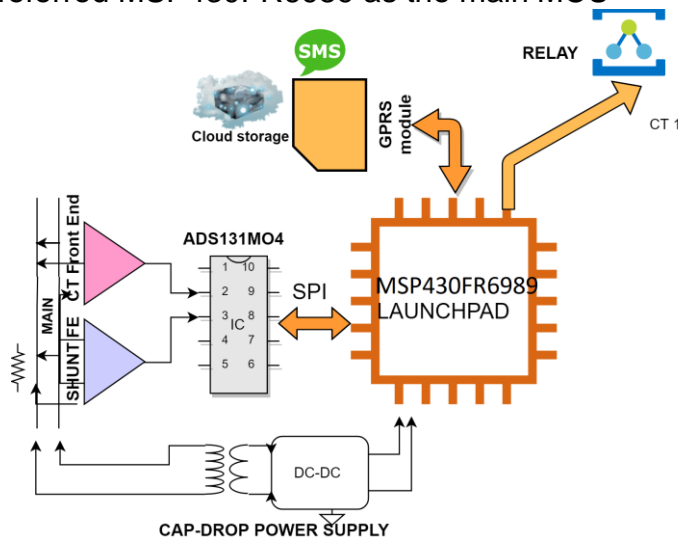
The functional algorithm of E-METER [click here](#)

The functional algorithm of DISTRIBUTION MONITORING METER [click here](#)



➤ Block Diagram for DISTRIBUTION MONITORING METER

Here we preferred MSP430FR6989 as the main MCU



ALTERNATIVE METHOD

Instead of using the server data accumulation we also analyzing an alternative method with SD card. Here the SimpleLink™ Wi-Fi® CC3220SF wireless microcontroller LaunchPad with SD card booster pack will maintain the device wise data and the data can be analyzed via wifi access point of CC3220SF with a smart phone. The total usage still uploaded to the main server via GPRS Module and the metrology is same as proposed above.

c. Innovativeness of the Proposed Solution

- Discrete Metering up to 32 individual devices using Decoder switching metrology.
- Accurate and efficient metering when compared to the mechanical meters.
- Prevent hookup power theft using cloud-based evaluation with DISTRIBUTION MONITORING METERS.
- Device usage limiting and usage alerts.
- Time-of-use-tariff update using RTC.
- Cloud-based billing and power disconnection.
- Device wise usage data acquisition and analysis
- Tariff estimated reading at any time.

d. Impact of the proposed solution

The existing meters are meant to measure only the mains power, but device or department wise power usage cannot be figured out from that value. Day by day power management becoming more relevant and unavoidable since most of the power is consumed by a few of the appliances. By limiting or maintaining these machines the consumers can reduce the electricity bill up to a great extent. By investing a reasonable cost both industrial and domestical consumers will find this as a huge advantage over the rising electricity bill. Analyzing each device enables enormous possibilities of power management and planning. On otherside, power line hookups can be easily located by inspecting the area distribution where the power theft event occurred. Thereby reducing electricity theft, we can overcome the tremendous loss.



e. TI Components Used

1. MSP-EXP432P4111 LAUNCHPAD
2. ADS131M04
3. MSP-EXPFR6989
4. CC3220SF-LAUNCHXL
5. 74AC11138
6. UCC28880D
7. BOOSTXL-SHARP128
8. TS3A5018
9. TPS7A7833PWPR

f. NON-TI Components Used

1. GSM/GPRS MODULES
2. CURRENT TRANSFORMERS
3. SOLID STATE RELAYS AND MECHANICAL RELAYS
4. INDUCTORS, RESISTORS AND CAPACITORS

