Outage Detection Unit for Smart Monitoring of Electric Supply

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Abstract— This paper presents a cost effective product to automatically monitor and detect outages in villages who don't have a reliable and intermittent supply of electricity. This product might prevent malpractices and corruption that linemen do by avoiding outage complaints and delaying the whole process, and hence, make the electric supply trustworthy.

Keywords- Arduino, sim900a GPRS/GSM module, mobile charger circuit, Internet of Things

I. INTRODUCTION

The substations that supply electricity from the power grid to the villages are not smartly monitored. When an outage occurs, due to human delay, villages don't get the supply for weeks. As a substitute, people use kerosene as a source of lighting resulting in harm to environment, wastage of resources and money. To prevent all this, the device provides real time supply data to be monitored automatically without any human delay and intervention. Once an outage has occurred through smart monitoring immediate actions can be taken to make electric supply more reliable and continual for the people. It is based on concept of Internet of things and uses GPRS/GSM for communication and a step down transformer along with a rectifier as a sensor to detect an outage. This research problem is posed under a MOU between Cluster Innovation Centre and Tata Power DDL.

II. MOTIVATION

Electrification of rural India has been going on since long when on September 2015, it is declared that 97.2% of 597,464 villages in India are electrified. This became possible because of tremendous efforts done by the Govt. by running programs like Deen Dayal Upadhyaya Gram Jyoti Yojana and Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY). But the supply is not continuous and more often during outages, in rural India people use generators, kerosene lanterns to produce light. This leads a lot of wastage of kerosene and diesel.

The following map shows that only Bihar is the state, where less than 30% households, does not have electricity as main source of lighting. Number of households in this category in the states Uttar Pradesh, Assam, Odisha, Jharkhand is the lowest as these states don't have a continuous supply of electricity.
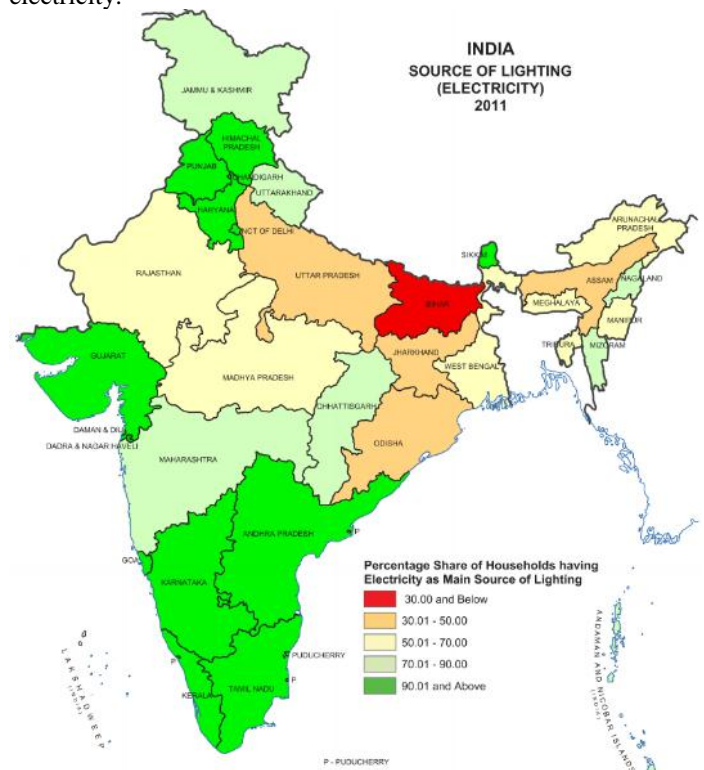

Figure 1: state-wise electricity usage as source of lighting, 2011

In the absence of electricity, people use kerosene in lanterns or diesel in generators as a source of lighting. The effected areas are the same five states which have an intermittent electric supply.
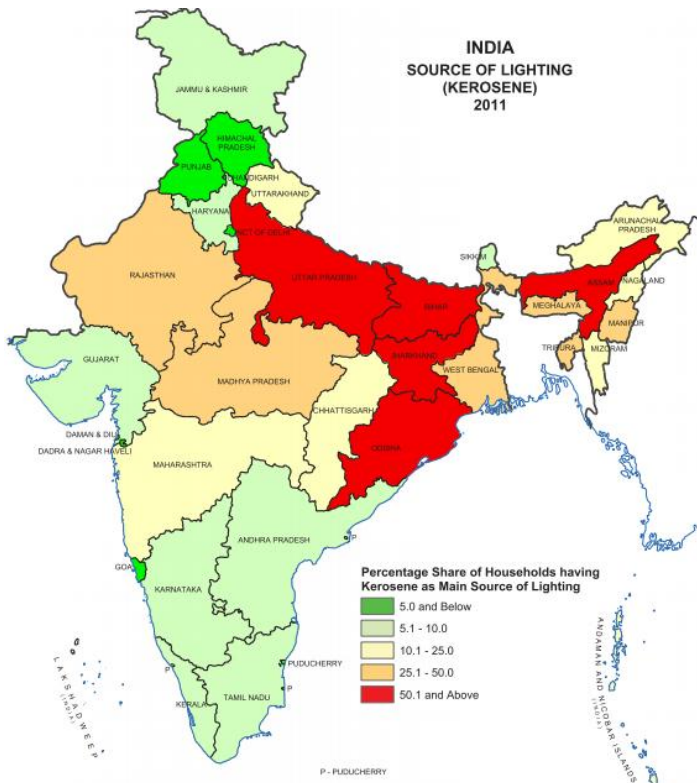

Figure 2: state-wise kerosene usage as source of lighting, 2011

The study of census data shows a clear trend that increase in supply of electricity decreases the use of kerosene in the households. In 2001, due to more number of villages having no electricity, approximately 43% rural households in India used kerosene, as their source of lighting, which dropped down to 31%, due to Govt. policies on rural electrification.
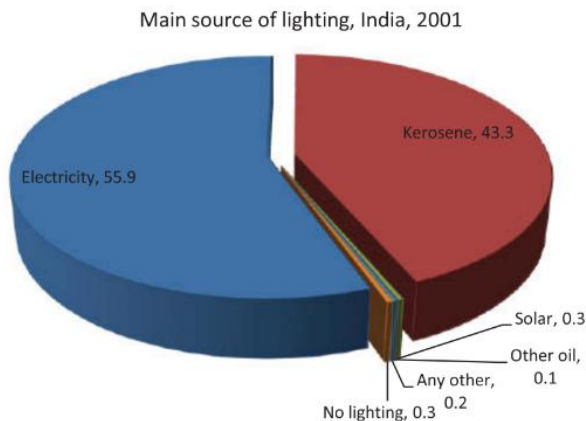

Figure 3: source of lighting, India, 2001

Lot of efforts are being done, to reduce, kerosene and diesel consumption, in order to conserve energy. In 2011, the use of kerosene decreased down to just 31%.
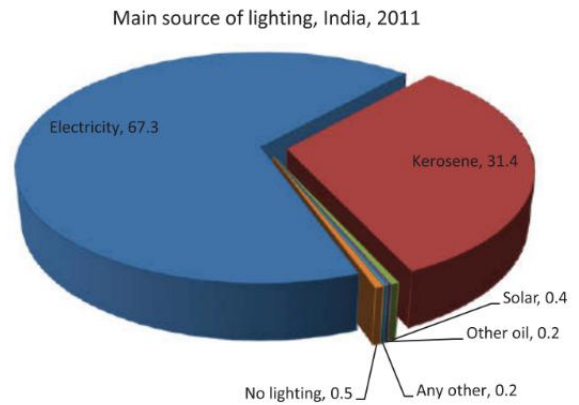

Figure 4: source of lighting, India, 2011

Still this 31%, can be brought down, by using smart monitoring systems at substations, and detecting outages and correcting outages at the right time.

III. PROPOSED SOLUTION

Using sensors and IoT network (preferably cellular network) and server scripting to monitor outage at substations automatically. It will require a device that will record values (current, voltage, and outage) at the substations and send them to a centralized server over a GPRS/GSM network to provide information to the concerned authorities. Now, these authorities can have real time information of outage occurrences and hence immediate actions can be taken to correct them to ensure a continuous supply of electricity.

IV. HARDWARE AND SOFTWARE REQUIREMENTS

A. ARDUINO UNO MICROCONTROLLER

Based on Atmega328, Arduino Uno is a microcontroller which has 14 digital pins, 6 analog pins, and other electronic hardware in a single package. It can be powered using an USB cable or an AC-to-DC adapter or battery. Arduino Uno will be used as an interface between the sensors and the IoT network.

Figure 5: Arduino Microcontroller

B.   Sim900A GPRS/GSM MODULE

Sim900A module is a GPRS/GSM based electronic device that used with a microcontroller allows you to connect to the internet. So, it will connect to the internet and using TCP/IP HTTP GET requests will send the data, collected from the sensors, to the centralized servers. It uses a SIM card for accessing the internet or calling services.

Figure 6: sim900a module

C.   OUTAGE SENSING CIRCUIT

A circuit which will be connected to the load lines. When there is supply it will give us a value, say 1, and when an outage occurs the value will be changed to, say 0, and detecting this change in value we can identify when an outage has occurred. The circuit uses a step down transformer followed by a rectifier to get an output of 5V while giving an input of AC supply.

D.   ARDUINO IDE

Arduino microcontroller's IDE for burning in codes to get desired outputs from the circuitry and hardware. Serial communication is used to read and write from the IDE to the Uno board.

E.   CENTRAL SERVER FOR DATA AND A MONITOR TO SEE REAL TIME DATA

A web hosting and domain server to receive data and a monitor for seeing the real time data coming from the hardware setup over the cellular GPRS network.
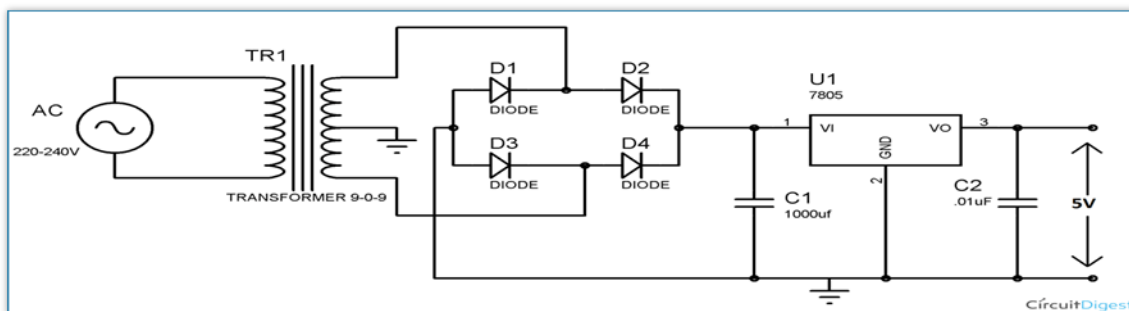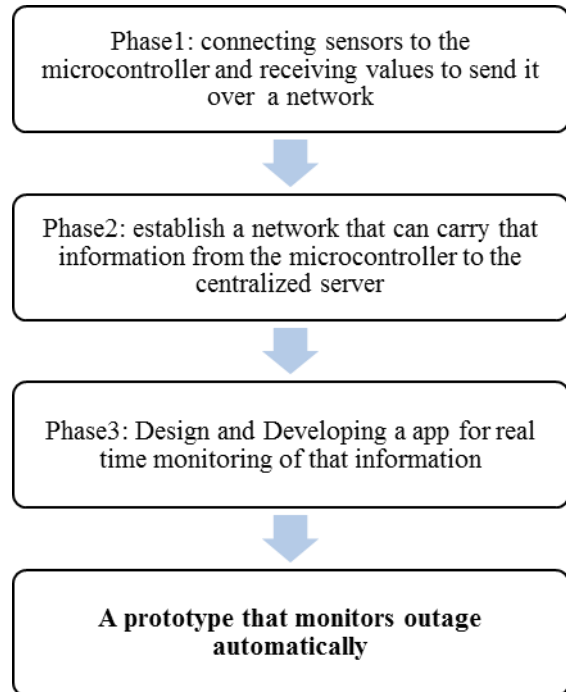
V.   METHODOLOGY

Figure 8: Flowchart

VI.   RESULT

The outage detection unit is highly beneficial to the organization. It helped the organization locate the outage points from average 30+ minutes to less than 1 minute which is integrated with the SCADA-OMS- GIS-CRM system; hence the same helped the organization to increase reliability, customer satisfaction and revenue. Following is a video link that has a working showcase of the prototype of "**OUTAGE DETECTION UNIT**":
https://www.youtube.com/watch?v=_2cRQ0Qb9y

Figure 7: Circuit Diagram

VII. DISCUSSION

With the outage detection unit substation monitoring will be unmanned, hence free from human errors. The monitor can be accessed sitting anywhere in this world. So, the superiors will have all the access to the data and the malpractices will not happen as everything is monitored, therefore, maintaining the transparency in the system. Immediate actions can be taken during an outage to get the supply back, hence, reducing the usage of kerosene and diesel to some extent.
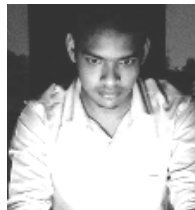
VIII. ACKNOWLEDGMENT

IX.   REFERENCES

[1] S. K. U. D. S. C. S. G. S. R. M. S. S. and S. V. K. , "ENERGY STATISTICS 2016," CENTRAL STATISTICS OFFICE.

[2] D. C. Chandramouli, "SOURCE OF LIGHTING," Houses Household Amenities and Assets.

[3] arduino.cc, "ArduinoGSMShield," [Online]. Available: http://arduino.cc.

[4] F. B. D. L. M. R. S. V. Mehdi Achour, "http://php.net/manual/," The PHP Documentation Group, 1997-2016 . [Online]. Available: http://php.net/.

[5] SIMcom, "AT Commands Set," Shanghai SIMcom Wireless Solutions Ltd, 2010.

[6] S. W. M. Amin, " "Toward a smart grid: Power delivery for the 21st century"," IEEE Power Energy Mag, vol. 3, no. 5, pp. 34-41, Sept.-Oct. 2005.

Authors Profile

Mr Saurabh Gupta is pursuing his graduation from Cluster Innovation Centre, University of Delhi, India and is currently working as an intern with Tata Power Delhi Distribution Limited. Having a great interest in the field of IoT (Internet of Things), he constantly keeps up building products based on it. As a matter of fact, the device presented in this paper is also an IoT product. Being a student of Information Technology and Mathematical Innovations along with study of electronics as minor subject, he does look forward to work in the field and create more and more of it.