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Power Theft Detection System

(Review Paper)

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Abstract: Electricity theft can be termed as fraud which can be in the form of meter tampering, illegal connections, billing irregularities and unpaid bills. The financial records indicate that most of the theft of electricity is in the form of stealing of power. In modern electronic meters, meter tampering and magnetic locking cannot be done. Hence now a days the most common type of power theft is done by hooking directly from the distribution lines. Electricity consumer dishonesty is a problem faced by all power utilities. Finding efficient measurements for detecting fraudulent electricity consumption has been an active research area in recent years. This project focusses on the detection of unofficial power consumption and high lightening some ways to prevent power theft

Key words - Power theft, Meter tampering, Micro controller application, Cause, identification and remedies of power theft

I. INTRODUCTION

Electricity has become one of the most necessary elements of our daily life. Nowadays, it is something that people cannot live without. It has become a necessary element for the survival of maximum human beings. But with the increasing need of the electricity, the electricity theft is also increasing and it will keep on continuing until some measures are not taken to detect and control it. With the advancement of technology particularly in the field of microcontrollers, all the activities in our day-to-day living have become a part of information and we find microcontrollers at each and every application. Nowadays, energy distribution/consumption has become a big subject for discussion because of huge energy theft. Theft in this case refers to a deliberate attempt to steal considerable amount of energy by ensuring no/low energy recording in the metering device. Hence, there is a need to think in this line and prefer a solution to this ugly trend. Thus, this paper focuses on electrical energy monitoring so that energy theft can easily be detected and huge penalties be imposed on these thieves. By detecting energy theft cases, the economy of a nation can grows rapidly. This research paper is aimed at developing a system which monitors and detects incidences of power theft, whether in the form of connecting load directly to the power line or bypassing the energy meter thereby paying less than what is consumed or by changing connection of lines. Higher energy prices reject consumers from buying electricity. Table II illustrates energy prices in different countries. which shows that how to increases tariff due to power theft. In light of this, rich and highly educated communities also steal electricity to escape from huge utility bills. To detect and identify the power theft location now a days used microcontroller and we gives a small application of microcontroller circuit for detect power theft. The type of microcontroller used for this monitoring and detection of power theft is AT89S52 microcontroller.

Review :- We have review different papers to get some idea

<u>Sl no</u>	Review Paper name	Work	Comments
1	<p>“Power Theft Detection in Microgrids” Aryadevi Remanidevi Devidas and Maneesha Vinodini Ramesh Amrita Center for Wireless Networks & Applications, AMRITA Vishwa Vidyapeetham (Amrita University), Kerala, India</p> <p>This paper published in- SCITEPRESS Science And Technology Publications.</p>	<p>In this paper they proposed wireless network-based solution for power theft, which is considered as a bane of power grid in most of the developing nations. they have proposed power theft detection algorithm (PTDA) which uses Kirchoff’s Current Law (KCL). they have identified three issues of PTDA when it will be used for micro-grids. To solve those issues with PTDA, they have proposed another algorithm called EPTDNA (Efficient Power Theft Data Networking Algorithm).</p>	<p>They Proposed a very good project in this paper. But if we can design a system to detect the power thefting without physical examine Then it will be more sufficient. The protection should be that much protected that fault should not be come in this system.</p>
2	<p>“A Novel Power Theft Detection Algorithm for Low Voltage Distribution Network” Arvind Kumar Gupta and Ayan Mukherjee Advanced Technology Development Center Indian Institute of Technology Kharagpur India-721302</p> <p>Aurobinda Routray and Rajashree Biswas Department of Electrical Engineering Indian Institute of Technology Kharagpur India-721302</p> <p>This paper published in- <u>IECON 2017 - 43rd Annual Conference of the IEEE Industrial Electronics Society</u></p>	<p>In this paper, a novel technique to detect two types of electrical power theft i.e. tampering and bypass of the energy meter, has been proposed. The technique involves development of a power theft detection algorithm as well as design of the associated hardware architecture. The proposed algorithm involves high frequency, low magnitude signal injection as a dye component into the power line and computation of PSD coefficients of current traces acquired at strategic locations followed by a threshold-based decision mechanism. The proposed algorithm has been implemented and tested in simulated environment as well as with real world data. For the real-world scenario, an experimental test bench has been set up to test the efficacy of the proposed algorithm. Using the test bench, the proposed power theft detection algorithm has been tested under a miscellany of real-world test cases. The power theft detection algorithm has performed satisfactorily under all such test conditions. The proposed power theft detection technique may play a significant role in curbing power theft. Further, the proposed technique can also be implemented in a single portable and low-cost system using micro-controller unit and Internet of Things (IoT) architectural designs. IoT based design would further strengthen the proposed architecture by adding provision of remote monitoring of electricity theft.</p>	<p>The Proposed system provides the solution foursome of the main problem faced by the Indian grid system. Such as wastages of energy, power theft, manual billing system and transmission line fault.</p> <p>This Method will reduce the energy wastages and save a lot of energy for future use.</p> <p>We can detect the location from where the power is being stolen which was not possible before.</p>

- Below we have discussed a overview of power theft and get a complete brief idea what is power theft and how to detect and prevent power theft

1 .What is power theft?

Power theft is the practice of stealing electrical power. Electricity utilities in India loss in crores of rupees every year to power theft. According to Section 135 of the Electricity Act 2003, electricity theft occurs when a person taps electricity lines, tampers with electricity meters or transformers or uses a device that interferes with reading or damages equipment such as electric meters or uses electricity for purposes other than authorized. If under the circumstances theft of electricity is detected, then the electric device can immediately disconnect the supply of electricity. The punishment for such offence is “three times the financial gain on account of this type of theft of electricity”. In case the person repeats the offence then the person is banned from getting electricity supply for not ‘less than three months but may extend to two years. Power theft is a serious issue that is not only against the law, but is also extremely dangerous. Power theft occurs when individuals tamper with electric service by trying to bypass the electric meter at a service panel. Tampering can create unsafe conditions that could possibly result in electrical shock, fire, explosion or death.

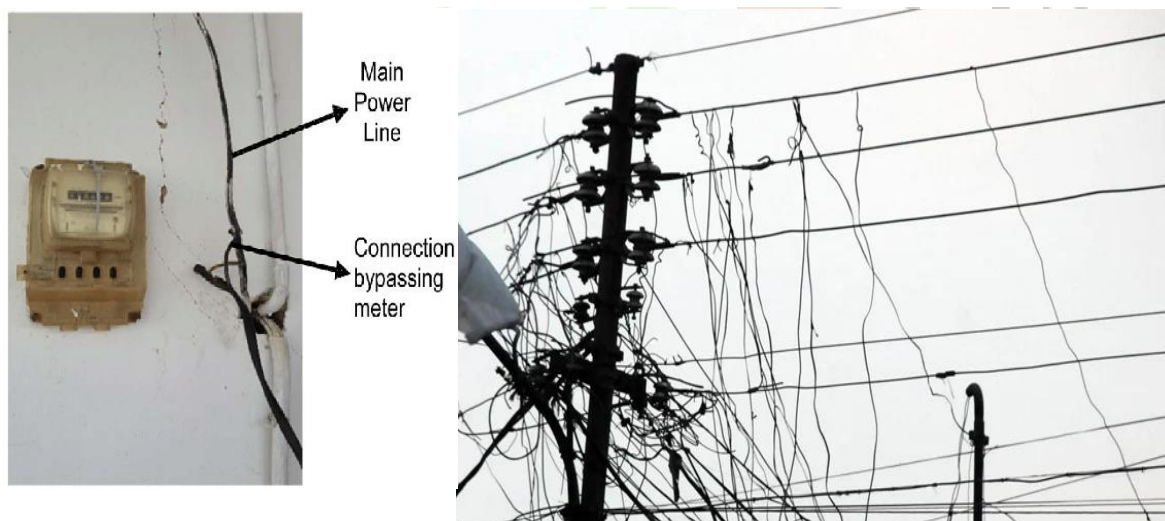
MID (Modes to Irrigation District) doesn't tolerate power theft and has the right to shut off power to those who commit this crime. MID's Electric Service Rules (Rule No.11 [5]) states that “the District may discontinue or refuse service or refuse to re-establish service if any part of a customer's wiring or equipment or uses of either unsafe or in violation of law, until such apparatus shall have been placed in a safe condition or the violation remedied and all related charges and fees for meter tampering, power theft/energy diversion, and broken or damaged District equipment have been paid by customer if they kept with power theft. If the District judgment observed that operation of a customer's equipment constitutes a dangerous condition, the district may discontinue service to that customer without prior notice.”

MID works hard to deliver safe, reliable and affordable electricity to all of our customers. So, we are requesting all the customers, people that if anyone tampers with a service panel by bypassing the meter and steals electricity, they put themselves and others in danger. Without power difficult to survive but stolen power will create fault and fire hazard in instruments and creates destroy not only goods but also destroyed homelives which is costlier among all. So, before theft of power, we should think out a little bit that it destroyed not only them but also others, society, nation, county, world. It is our duty to take power by authorised ways and pay bills regular basis then only we will be safe and make safe others, nation, country. We are Indians, we love our country more than our lives, so we cannot make unsafe by theft of power. Power theft is a crime

1.2 Types of Power Thefting-

Direct hooking from line-

cable hooking is the most used method. 80% of global power theft is by direct tapping from the line. The consumer taps into a power line from a point ahead of the energy meter. This energy consumption is unmeasured and procured with or without switches. It can cause severe electric shock or fire outbreak.



Bypassing the energy meter

In this method, the input terminal and output terminal of the energy meter is bridged, preventing the energy from registering in the energy meter.

Injecting foreign element in the energy meter-

Meters are manipulated via a remote by installing a circuit inside the meter so that the meter can be slowed down at any time. This kind of modification can evade external inspection attempts because the meter is always correct unless the remote is turned on.



This type of tampering is done to electromechanical meters with a rotating element. Foreign material is placed inside the meter to obstruct the free movement of the disc. A slower rotating disk signals less energy consumption.

ESD attack on electronic meter-

This type of tampering is done on electronic meter to make it either latent damage or permanent damage. Detection can be done correctly in high end meters only.

1.3 Why Power Theft is Happening?

Power Theft is happening in all over the world. Higher electricity prices, poor quality of power supplied, corruption, poor enforcement of the law against electricity theft, and the PURC not fighting for the interest of consumers were found to be the main causes of electricity theft.

Lack of available capacity, weak infrastructure and poor electricity supply governance are recognized as the main causes for such a generalized failure. With regard to governance, it has been suggested that more than 20% of the total electricity generated in India is stolen

In general terms, the theft of electricity is the criminal practice of stealing electric power. It is an offence and is punishable with fine or incarceration. It pertains to non-technical losses. Non- technical losses are losses caused by the action exterior to the power system.

The Electricity Price per Unit is Very High.in our country There is lots of Poor people lived they don't have proper earnings for giving the electricity bill. This is also main reason of Power Theft

1.4 The reasons behind power theft in India: -

The power system losses in India can be classified into two categories- technical and non-technical. According to a study report, technical losses are losses caused by actions internal to the power system and consist mainly of power dissipation in electrical system components such as transmission lines, power transformers, measurement systems, etc. On the other hand, non-technical losses (NTL) are caused by actions external to the power system, or are caused by loads and conditions that the technical losses calculation failed to take into account. These losses are essentially monetary or commercial losses. There are mainly two forms of power theft in India. One is meter fraud (manipulating the electricity usage data) and the other is unmetered usage (where power is enjoyed for free).

Political interference too is sometimes responsible for it. It is seen that in many parts of the country, power theft increases during elections. Since farmers form the majority of the country's electorate, political leaders often promise them free or subsidized electricity in order to get votes. Also, most of the overhead electrical wires in India are still not insulated and that invites illegal hook-ups.

Economic reasons: - In India maximum percentage of population lives in village or semi urban area. Due to digital India and modernize of society power demands are increasing rapidly but economic growth or average earning of people are not increasing likewise, fulfillment of requirements of daily needs or entertainments needs maximum people are doing theft of power.

Festival Reasons: - Indian culture is culture of festivals. Festivals, Pooja, occasions are occurred every days/every month. Maximum programs are happened outside of home. We are live in PARA culture. Beside of taken legal power, maximums are taken illegal powers by simple hooking.

Political issues: - Another important issues of power theft are political reasons

i) Number of open yard meetings are always occurred and it is highest in time of elections, At that time huge amount power has been taken legally or illegally it is taken legal ways but tariff has not credited on time in power distribution company, it make pending years to years. That is also theft.

ii) Political are distributed free of cost power which is also one kind of theft of power, because generation of power is too costly and our maximum power is generated through fossil fuel. The storage of fossil fuel is limited and very costly. So, this effect indirectly to tariff plan, costlier tariff plan will create tendency of power theft.

iii) Digital India: - India is rapidly progress in use of digital instruments, ideas, technologies. It has good effect as well as bad effect because now a days maximum people know how to reduced or convert their higher bills to lower bills by some technologies which is very difficult to identified or tracked.

iv) Uses of Unauthorized loads: - Now a days maximum uses of high-capacity loads of AC in industry or domestic uses are not taken legal permission from distribution companies due to deposited of extra amount in distribution company and creates dangerous effect in whole transmission lines.

v) SMS alert: - Now a days distribution companies are sent meter checking dates via SMS which makes consumers to easy of power theft. Meter checking dates are generally 1st or last week of every month. For that reasons Consumers are theft power remaining of those dates, for those reasons, it is difficult to finding power theft and it is difficult to find them in red hand.

Reasons of power theft is uncountable. But we have to focused how to prevent power theft properly with simplest method. If prevention is complex then no fruitful result will achieve. If we are not think about power theft then it will destroyed economy of power industry, So power theft can be compared with Termite (In Bengali WIPOKA)

2. Impact of Power Theft

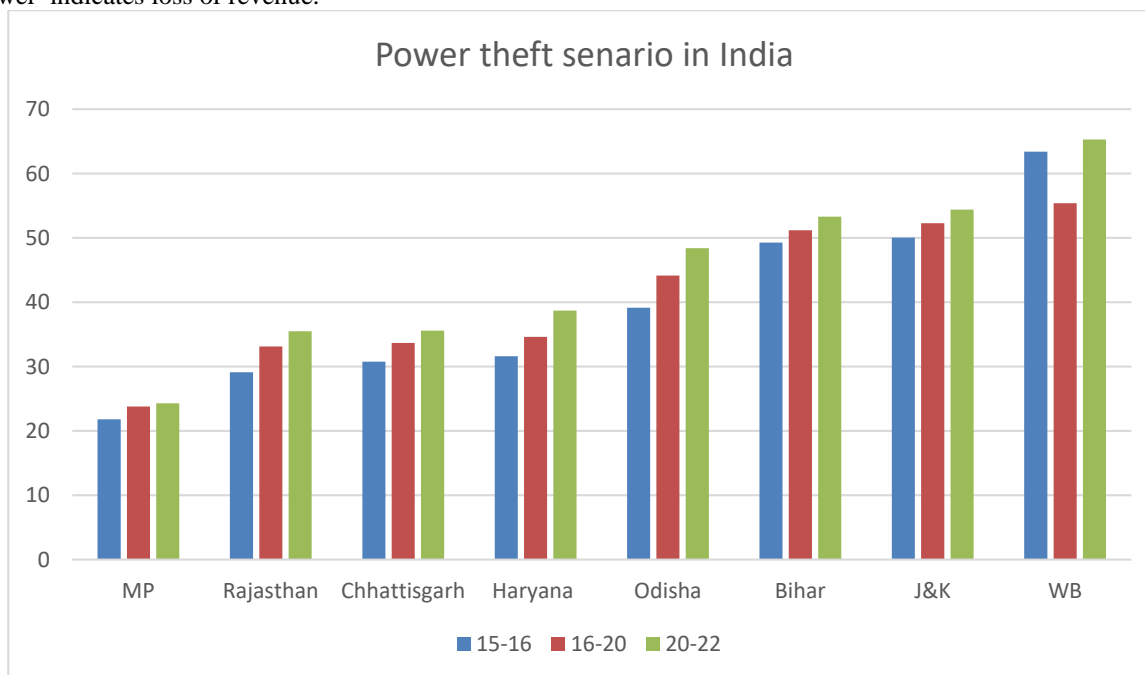
No advantages of power theft. So, the effect of power theft is very large in any country. In India it has huge effect in financial, technical, social, political and security areas.

Area	Reasons & Effect	Remedies	Planning
Financial	<ul style="list-style-type: none"> i) Huge amount financial loss (65% tariff unpaid due to theft) ii) Energy mismatching (Generation and demand), huge amount penalty factor imposed in discom. iii) Active and reactive power loss more, maintenance is more costly. iv) Tariff will increases, and reduction of theft is not occurred, it increases theft more. One power theft indicates more power theft in future. v) Power system planning, design, installation is costlier. vi) Voltage drops increases create instability in PS network. vii) voltage sag, swells, dips, harmonics more. viii) Fuel cost increasing ix) Blackout, loadshedding, out step more in PSN. 	<ul style="list-style-type: none"> i) Proper identification and detection of power theft required. ii) Influence of political effect must be reduced iii) Give all legal freedom to cut the illegal lines. iv) Properly restructure environment required v) Only taking policies will not give solution of theft power, proper implementation required. vi) billing alert and meter reading dates should not be fixed time line, vii) Surprise visit essential. viii) Government work culture should be proper ix) Awareness camping required. x) Design attractive tariff plan required. xi) economical subsidy given not for all. xii) large scale Industry should be focused more. xiii) Implement Underground transmission more 	<ul style="list-style-type: none"> i) Government has taken so many powers act rule to prevent power theft. ii) Focused properly in restructure environment in Power sector. iii) More focused in nonconventional generation (mainly solar and wind) iv) Implement advanced smart meters for every customer. v) Create more employability in power sector and solve issues of shortage of manpower in power industry.
Technical	<ul style="list-style-type: none"> i) Free of Cost power in paddy area ii) Lack of underground power transmission iii) Low Voltage level iv) AC power, low risk, neutral present always. v) old structure of PSN. 	<ul style="list-style-type: none"> i) Stop supply free power. Otherwise cost of power will increases and consumers are not able to take legal way power connection ii) More research required iii) give more emphasised in renewable energy in every building and house. 	<ul style="list-style-type: none"> i) Government has given more rebate in renewable energies. ii) Proper way and placed Government tenders iii) Always monitoring every area load flow via SCADA.

	<p>vi) Not using proper instrument.</p> <p>vii) Improper design of transmission lines.</p> <p>viii) Clumsy design of poles and towers</p> <p>ix) failure of insulation of different instrument</p>		<p>iv) Give extra budget for power to make the system more healthily.</p> <p>v) HT and LT lines must be design with HVDC.</p>
Political	<p>A third type of loss is electricity is gratis. Some power system provides free electricity without charge to certain people and organisations. The presidential or prime-minister's residence, members of parliament, or royal places may not charge for electricity. So, billions revenue losses occurred. That also theft.</p> <p>Now in WEST BENGAL we paid approximate residential 6-10 rupees and commercial 15-25 per unit which is subsidies tariff. If thefting occurred continuously like these ways who tells near future per unit charge will not increased in 100 rupees/per unit just like price hike of LPG for domestic and Industry. Then reduction or solution of power theft will far behind and consumers are theft power more and more, ultimately whole power sector may collapse or privatised.</p>	<p>i) It is the time of take decision to stop the free cost power or fixed the uses power limit.</p> <p>ii) subsidies power only given below poverty lines.</p> <p>iii) unpaid government bills must be paid within stipulated time periods; no delay has been allowed just like normal customers.</p> <p>iii) Proper ways tax collection required</p> <p>iv) All employees of PSN should maintained their honesty and work culture (Maximum PSN is run by Government)</p>	<p>i) Distribution of free power should be stopped by passing government bills in parliament.</p> <p>ii) Implement more and more renewable energy in every house, office, industries,</p> <p>iii) Proper training and awareness required. Otherwise we will not provide external lightening for society and illegal works will increases rapidly.</p>
Security	<p>Due to power theft lack of security occurred in PSN which creates faults in transmission and distribution and mal operation of protection.</p>	<p>i) Hamper Road lightening and security of inhabitants (specially girls, women) are reduced and accidental cases occurred more.</p> <p>ii) If lightening will not provide every hook and nook corners of India women's, children are not safe. Each and every day occurred theft, murder, blackmail, rapidly occurs (just like UP)</p>	<p>i) Quick action and implementation required</p>

India's power companies lose revenue on about a fifth of the electricity they supply, or about USD 10.2 billion annually, due to problems including theft, meter tampering, billing issues and leakage due to faulty equipment. The World Bank estimated that in 2011 power sector debt reached INR 3.5 trillion (USD 77 billion), that is 5 pc of India's GDP. Of all the power generated in the country, around one fourth is either stolen or lost in transmission.

Transmission and distribution losses at the national level in India were about 22.77 pc in 2014-15 and 21.81 pc in 2015-16. Some states incurred higher losses than the national average in FY15-16 and these include Madhya Pradesh (28.61 pc), Rajasthan (29.13 pc), Chhattisgarh (30.78 pc), Haryana (31.61 pc), Odisha (39.15 pc), Bihar (49.29 pc) and Jammu and Kashmir (50.06 pc). So theft power indicates loss of revenue.



So, it is seen that power theft is increases day by day. So, it is time now to think and research about power theft otherwise tariff will increase sharply which will affect more power theft and shutdown of power generation.

3.Power Theft Detection-

Nontechnical Power theft is normally done by bypassing or hooking. So, to stop this we have to implement different methods

- Voltage & Power loss Analysis:** -Proper load flow analysis is required to identifying power theft. From load flow we have to identify area where overvoltage, voltage drop and power losses are going to beyond limit.
- Application of modern technology:** - It is very difficult to identify power theft from big data sets. So individual cluster analysis is important. Power theft is normally done by two methods that is bypassing or hooking. So, to detect it, a system (current measuring and comparing) is proposed in which the household distribution of current is done indirectly from the electric pole to an intermediate distributor box and then to the individual houses. The current is measured periodically in the distributor box and is posted to the server database for each house using GSM/GPRS module. Similarly, for each house electric meter is designed which can measure the value of the current and post the same to the server database periodically using GSM/GPRS module. At the time of the installation of the electric meter the details of the users are stored in the database through a user-friendly mobile application including the address, latitude, longitude using mobile GPS and the photograph of the user's house/area. Upon successful comparison between the current values from distributor box and electric meter in the server if we get a marginal difference between the currents then the theft is detected. Finally, the details of the user are shared with the authorized mobile application including the address and photograph of the area. The latitude and longitude are also used to show the area of theft in Google maps. And hence the required steps are taken. The same process is used for hooking but on the individual electric poles

4.Objective and Brief Workflow

The power distribution sector has been played with distribution losses (overall 30%) coupled with theft of electricity. To minimize the theft of power by bypassing or by hooking we are proposing a web based MOBILE APPLICATION which will notify about the theft of electricity that is happening in a particular area

The main objectives of this work are

To detect the power theft automatically without engaging any man powers by developing a cost effective and efficient system.

- To develop a web based mobile app for the authorized officials of electricity board to keep track of all the thefts, area of thefts and the direction to reach the area under theft.
- To maintain the record of the total number of electric units consumed by users in the server database periodically and make online bill payment system.
- Get overall idea of power theft

To develop a global website that would maintain the analytics of the thefts and the probable area under theft using multi-color graphs and pictorial representations which would make the theft analysis easier and can also predict the thefts that may happen in future schemes are available for the same and a scheme using smart electric devices employing electronic energy meter is used.

5.Prevention of Power theft

Smart and connected meters-

Distributor company increasingly use new technologies to avoid power theft, fraud. For that reasons DISCOM introduce smart meter in every residential and commercial connections and change old conventional meters with smart meter free of cost.To reduction of power loss utilities having great responsibility that they should change their loads with led or energy saving instruments.

Network shielding

By Network shielding used to prevent power theft.All equipment and electrical infrastructure can be shielded to minimize and avoid the theft of energy.

Increase Voltage in Distribution Line

If we increase the voltage of Distribution Line 230v to 280 or 290 and we can add a device to the consumer home to convert the voltage to 230 then the theft can be decrease.

6.Conclusion & Future Scope

The traditional detection methods of power theft mainly rely on the scheduled operations of technicians who work in power supply enterprises. The operation goes with reading the electricity meter and then recording, counting, and performing manual analysis and calculation but this method does not give satisfactory result. So we think about new methods and process how to identifying power theft and prevent it to save the Power Industry. This is a review paper discuss some ideas, aspects only for research analysis.

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