**\*we are still adding features in this project to make it more relevant and more distinctive. We are discussing about a Smart Home System that features not just power theft detection system but also a biometric security systems and more features that can meld on our project. Examples are home wattage chart, thermostat, smoke detector, intelligent energy consumption.**

**NATIONAL UNIVERSITY MANILA**

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**COLLEGE OF ENGINEERING**

**Power Theft Detection System with Energy Management**

***Submitted in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Electronics Engineering***

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**Chapter 1**

**Introduction**

This chapter is composed of the background of the study, the significance of the study, objectives, scope and delimitations, and conceptual framework. This chapter discusses the reason that led the researchers to choose this topic as well as the problem it tackles and how it solves those problems.

**1.1 Background of the Study**

Electricity theft is a criminal offense of stealing electrical power. In the recent issue, Santa Rosa City Rep. Dan Fernandez believes that the Energy Regulatory Commission (ERC) has allowed power distributors which include the Manila Electric Company (Meralco) to earn more than they should, as per Republic Act (RA) 9136. He argued that under RA 9136 or the Electric Power Industry Reform Act of 2001, the ERC should have conducted a re-computation of the weighted average cost of capital (WACC) during the fourth regulatory period from 2016 to 2019. “ERC’s inability to do its responsibility as provided by law is highly suspicious. As a result of their negligence, ERC officials made electricity cost in the country one of the highest, if not the highest in the region,” Fernandez previously said in a House Committee on Energy hearing last Thursday, Sept. 15. [1]

The practice of stealing electricity is nearly as widespread as it is in electricity distribution.  Electricity theft is done in a different kind of means, from methods like directly hooking a power line, to manipulation of the electrical meters.  Electricity theft is most common in the Philippines where power grids deliver inadequate and unreliable power most especially in squatter areas in which other communities are affected.

Stealing electricity is punishable under RA 7832. The theft of electricity by the methods mentioned above carry a jail sentence of up to 12 years. Despite this hefty punishment, it is still widespread. The threat of punishment is negated by the lack of implementation as detection is often happenstance instead of a reliable system.

 The aim of this study is to design a system to solve the problem of abnormal monitoring of power consumption at the same time to manage the energy of our homes. This project helps in detecting power theft and if possible, to locate the area in which power is stolen. This project detects power theft with the help of various sensors placed in respective regions and alerts the authority using the GSM module. To detect, a system 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 Arduino UNO controller is the proposed used in the upcoming system. A signal will be sent from the consumer side to the substation side in case there is a difference in the compared values.

Our group chose this topic because of our social problem. With this project, it can be a source or a system to partly solve the problem. Electricity theft is responsible for our economic problems for the electric utility due to revenue loss caused by electricity consumers that are not paying for it resulting also in power quality problems. An increase in power demand to values greater than the transformer rated power can result in different quality deviations, like transformer overload, voltage unbalance and steady state voltage drop on system buses. [2]

**Objectives of the Project**

The Idea of the Proposed System in this paper presented is a wire control system that provides a solution of power theft problem by placing the system which will be constructed utilizing the Arduino UNO microcontroller. Arduino with current sensor and voltage sensor will be formed as a number of Master and Slave boards. The proposed system was designed to detect exactly where the probability of both "the power theft" and "the excessive power usage" have occurred in a specific home. The project will assist in the distinction of illegal consumption. However, the Microcontroller will be interfaced between the energy meter and a wire communication network in order to transfer data. A signal will be sent from the consumer side to the substation side in case there is a difference in the compared values. The paper shows the technique of transferring data from Slave board, which is supposed to be connected with consumer side, to Master board, which is supposed to be connected with substation side . Actually, using a communication module to wirelessly send data is easier, more interesting, and reliable. While, sending data using wire style is less expensive. However, sending a notification message to inform GECOL that there is an additional unexpected consumption detected in that specific home or in that particular electricity pole. As a result, GECOL can ensure whether or not this detected power is authorized by the company. Consequently, the power theft once detected in the procedures will be taken by the European Journal of Engineering Science and Technology, 2 (2):49-58, 2019 50 the company. The Master and Slave boards consist of same components (explained in section 2). As each board has a different functionality, the difference between them is the code written in C/ C++ language.

**Significance of the Project**

This project intends to create a machine that detects the Theft of Electricity of our household. Electricity theft has a major impact on the electricity system in the Philippines. Some examples are that the theft of electricity results in loss of revenue to the utilities, it disturbs the local area supply which leads to overloading of transformers creating blackouts or brownouts. Also, it damages the property of the utility. Electricity Theft also results in fires, explosions and other circumstances.

The importance of this study is to help the engineering field for a more reliable and accurate way of diagnosing and monitoring the Electricity System. It is done to cater everyone in the community in monitoring the overall supply of power. In this way, the detection of theft system can be done and fatalities stated will be reduced. Moreover, the risk of theft will be reduced because the system will have knowledge about abnormalities and it can be a way for the people to report such theft.

**1.2 Consumers**

This study should contribute to potentially increasing the productivity of electricity which will help the consumers obtain more safe and quality consumables.

**1.3 Government**

The concept presented in this study will benefit both the Department of Energy (DoE) and the Department of Science and Technology (DOST) because the DOST has recognized the necessity of product development of okra that is stated on the Harmonized Nation Research and Development Agenda for 2017-2022 under Section 4 F where it stated in Renewable Energy and Energy Storage Solutions.

**1.4  Future Researchers**

This project can help future researchers on the algorithm of supervised machine learning through analysis of specific variables to identify certain parameters. Future researchers may also use this research to make a better system that has a wider coverage area.

**Scope and Limitation of the Project**

As various technologies and techniques develop in sustainable electronics materials nowadays, this study's main difficulty is gathering techniques of practical application regarding Arduino Uno and its system due to the Covid-19 pandemic resulting in online learning and online testing only on TinkerCad Application on the internet. Thus, by researching online, fulfilling more knowledge on Arduino Uno and C++ Coding, our group hopes for a productive and a successful outcome. The study will need research work serving as a basis to work on the development of the Power Theft and Energy Management System. Mainly, the advances of this Project in technology and innovations today will serve as a case study or guide on how to improve the system properties and capabilities further. The study will include the primary data and C++ coding regarding the technical information of the Arduino Uno properties. It will contribute to the Electronics Technology to further improve and enhance its full potential properties and capabilities.

The study also has to be limited after the electric meter to monitor for theft within an end consumer’s system. This limitation is dictated by the very laws that our system intends to detect. Should we implement it before the meter it would fall under tampering that is punishable by RA 7832.

**Definition of Terms**

**Arduino Uno -** Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. [4]

**Microcontroller -**A microcontroller is a compact integrated circuit designed to govern a specific operation in an embedded system. A typical microcontroller includes a processor, memory and input/output (I/O) peripherals on a single chip.

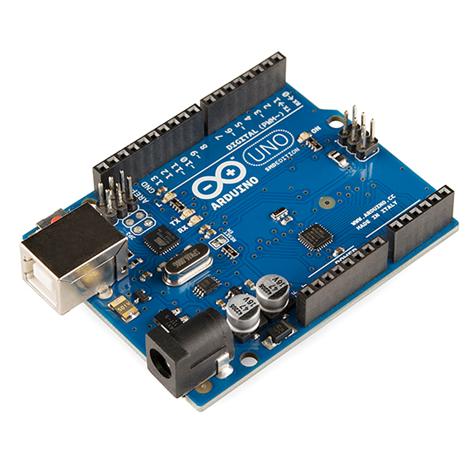
**Microprocessor -** A microprocessor is a computer processor where the data processing logic and control is included on a single integrated circuit, or a small number of integrated circuits. [3]

**Reliability** - the degree to which results are consistent.

**Chapter 2**

**REVIEW OF RELATED LITERATURE**

This chapter presents related studies that support the project. Both foreign and local studies are considered.



**Arduino Uno**

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.

Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments. [5]

**Meralco Outages**

The cause of an outage depends on whether it is a: (1) Planned Outage and (2) Unplanned Outage.

A **Planned Outage** happens to allow Meralco to conduct maintenance activities, upgrade line and/or substation equipment and facilities, relocate facilities as necessitated by government projects (e.g., road widening), or construct and extend facilities to serve additional customers. If you’re going to be affected by this type of outage, Meralco will advise you at least 72 hours before the actual time of service interruption.

An **Unplanned Outage** is usually a result of emergency conditions that lead to electric service  shut off. It may be caused by factors that are beyond Meralco’s control, such as generation deficiency, adverse weather conditions and foreign objects hitting or coming into contact with power lines and equipment. Failure of line hardware, components and devices directly connected to power lines also cause this type of power outage. If you are affected by this type of outage, you can view and monitor the status via the outage map. If there is no available outage information in the map, you may file a report through the outage reporting form. [6]

**Electricity Theft**

The law concerning electricity theft in the Philippines is Republic Act No. 7832. The law covers those that install illegal connections and/or tamper with metering services. The punishment is up to 12 years imprisonment. Most of the study would concern itself with section 2. Section 2 deals with the theft and misuse of electricity by illegal taps and meter tampering. An actual monetary incentive can be taken for the basis of the study in section 5 as a minimum of P5000.00 is authorized in section 5 as a reward for the information for infringement on section 3. Unfortunately, section 3 deals with the theft of the distribution system itself and not the electricity but a missing section of powerline will definitely show up as an abnormality on a monitoring system.[7]

**IoT Based Smart Power Quality Monitoring and Electricity Theft Detection System**

A proposed system to combat electricity theft, the IoT based power monitor is a potential solution which monitors the electricity distribution within a network and finds parts of the electrical grid that have been tampered or experienced power consumption beyond a specific value.

The system is composed of a network of sensors that transmit real-time data on power consumption and processes them through IoT tool ThingspeakTM to allow fast analysis and reactions to abnormal power consumption.[8]

ThingspeakTM is a cloud based data collection and analysis application that provides real time analysis and visualization using MATLAB, and also triggers a reaction based on the analyzed data. It can also design prototypes and virtual systems, and communicate with other third-party services for fast and automatic actions based on aggregated data.[9]

**Chapter 3**

**Methodology**

**3.1. Introduction**

This section covers the proposed methods to achieve desired outputs, flow of the system, considerations of the study, testing procedures, and statistical data analysis

**References**

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[5]<https://www.arduino.cc/en/Guide/Introduction>

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[9]<https://thingspeak.com/pages/learn_more>