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AN INTELLIGENT SOLUTION FOR ELECTRICITY AND WATER MANAGEMENT IN SMART CITIES USING INTERNET OF THINGS

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Abstract - *Electricity is one of the basic utility that almost whole world depends on it. There are many unstable issues such as losses which occur due to properties of materials used in the transmission unit, illegal consumption, etc, leading to abundant loss of power. Water is another important resource whose need in our daily routine is undeniable. In real time operation, water distribution department is facing more problems due to the shortage of water. The demand for energy is ever increasing due to population growth. An intelligent solution for energy management can be done by proper monitoring and control these resources using internet of things. To attain this, have to design a reliable system in such way that the consumer will be aware of their consumption pattern. Amount of power delivered to the individual units is measured by the sensor and from this value, the illegal consumption of power can be calculated. The water level in the tank is measured using the level sensor which is used to control the motor. The Sensors sends effective data to the raspberry pi and raspberry pi is connected to the internet. At the backend, the status of energy consumed can be known.*

Key Words*: *Internet of things, raspberry Pi, electricity theft, water management.

1. INTRODUCTION

Electric energy is one of the basic utility that the whole world is depending on it and it is a necessary resource in everyday life. Tremendous time and money are spent in the production of Electricity. We can't assure whether all the generated electricity reaches the consumers without loss. Proper usage and measurement of consumption of electricity are very important.

They are two types of losses

(i) Technical loss- As electricity is transmitted over long distance there must be a loss due to the characteristics of the transmission material. Only a few amount of electricity is lost so it is negligible.

(ii) Non-Technical loss- Huge energy loss due to illegal tampering with the meter, Illegal terminal taps of overhead lines on the low side of the transformer, etc. This illegal loading is said to be electricity theft

Electricity theft has become a crucial problem so it is necessary to take it into an account. Initially, Energy meter is used to calculate the consumption of electricity in individual houses but it couldn't able to find out the theft location. To attain this, an automated electricity distribution system is proposed to ascertain the exact location of the electricity larceny.

Water is the most precious and valuable resource because it is one of the essential resources needed to live on earth. In real time operation, water distribution department is facing more problems due to a shortage of water. There are enormous reasons for low availability of water.

One of the main reasons is that the increase in population proportionately increases the consumption of water. So here comes the need for conservation of water. To overcome this problem, an automated water distribution system is proposed to supply water equally to the individual houses. A proper monitoring and control system has to be implemented to minimize the over usage of resources. The overall electricity and water management system are proposed using IoT (Internet of things) platform.

2. METHODOLOGY

In the proposed system, the Current sensor is used to measure the amount of power consumed by the user. The sensor is placed in Electricity Distribution Board as well as in each and every individual house to measure the amount of power being consumed by them.

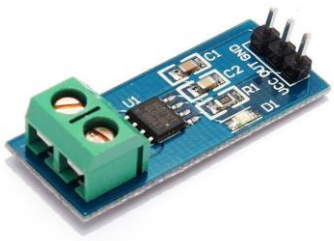

Fig.2.1. Current sensor

The current sensor continuously monitors the amount of power distributed to all the houses in an area and sends this information to the gateway (Raspberry-Pi) through MCP3008.

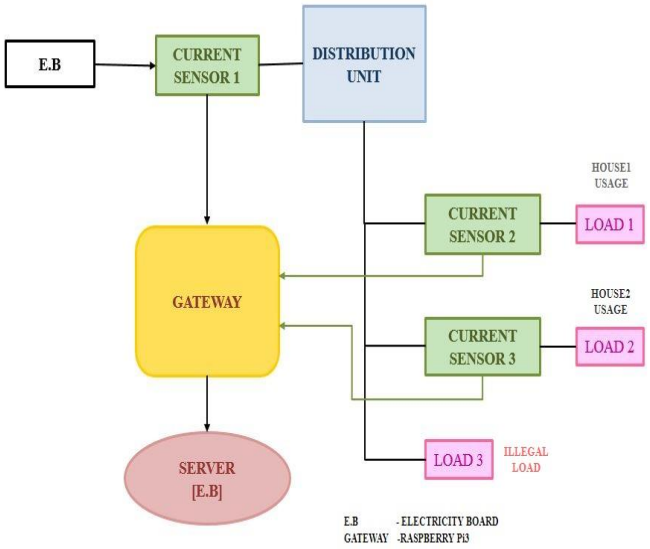

Fig.2.2. Electricity unit

The output pins of the sensor are connected to the channels of MCP3008. It is a 10 bit analog to digital converter. It is a part of the serial port interface circuit. Since a 230V of alternating current is given to the sensor, it cannot be directly connected to the raspberry pi. Hence we use MCP3008, an ADC which is then connected to the raspberry pi.

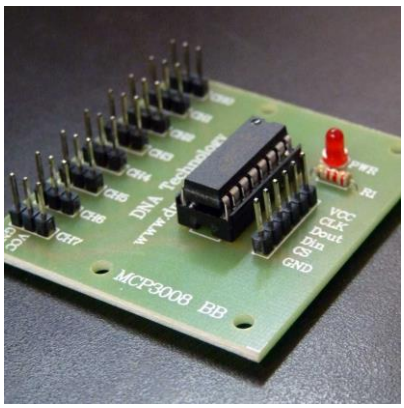

Fig.2.3. AC to DC Conversion

All these information from the gateway will be passed on to the server. The server will check by comparing whether the total amount of power from each and every individual house is equal to the amount of power distributed from the distribution unit. It is equal then there is no problem and the power is used in a proper way. Suppose the record of the total amount of power consumed each house is not equal to the distributed power then the power is being illegally consumed by someone, immediately this comes to the knowledge of the server and further actions will be taken in that particular area.

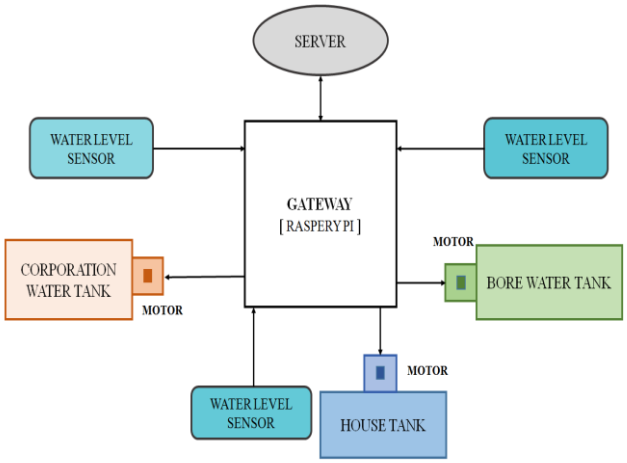

Fig.2.4. Water Distribution unit

The water distribution system is designed with three units. Each unit consists of a motor, a sensor, and a relay. The ultrasonic sensor sends out a high-frequency sound pulse and checks how long it takes for the echo of the sound to reflect back.

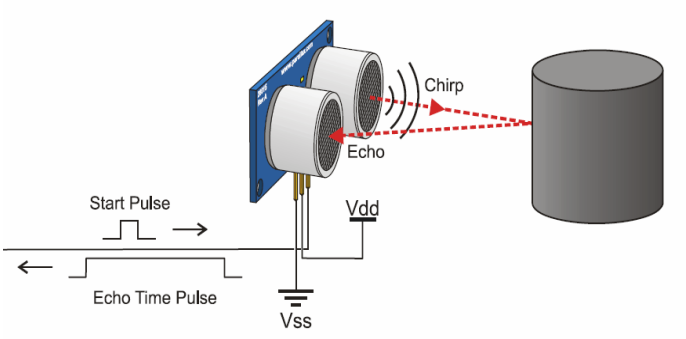

Fig.2.5. Ultrasonic sensor

The sensor has two openings, one is a trigger and the other is an echo. The trigger makes high-frequency sound waves. These sound waves are passed through the tank from top to bottom. The sound waves hit the water and reflected back in the form of echo waves. The echo opening receives the echo waves. The speed of sound is 341m/s in the air. The ultrasonic sensor uses this information pulse to determine the distance from the water.

Distance = (speed X time)/2

When the information is received by the gateway it will check the level of water in the tank by using ultrasonic sensors that are fixed at the top of the tanks. With that information from the sensors, the gateway controls the motors. If there is no sufficient amount of water in the tank, the motor will run and fills the tank with water, otherwise, it will not run. Thus the overall process is controlled by the gateway (Raspberry-Pi).

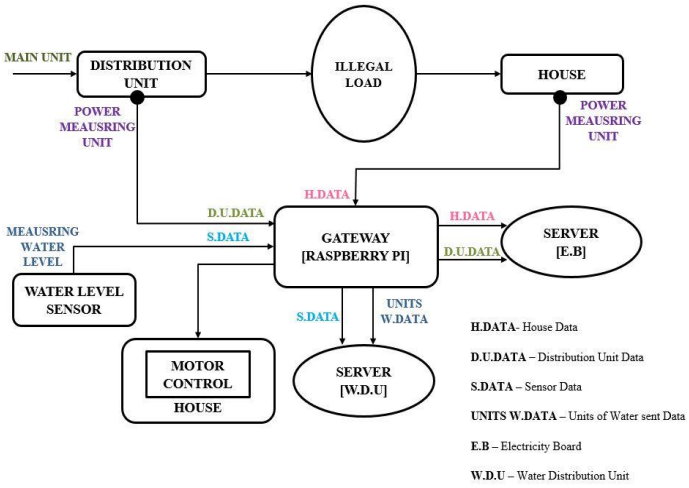

Fig.2.6. Overall System

The Raspberry Pi 3 Model B has better features than its predecessors with a new, faster processor on board to increase its speed. It has advanced features like built-in WiFi and Bluetooth, USB ports, WiFi, Ethernet, 2.4GHz wireless, Bluetooth, 40 GPIO Pins, Ethernet Port, HDMI Port, Micro SD card slot.

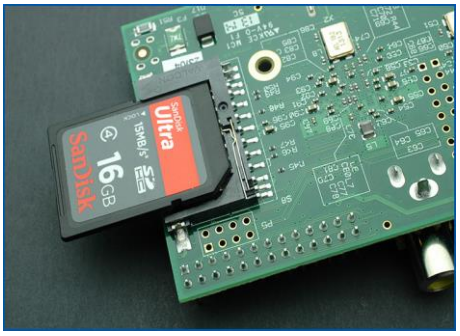

Fig.5. SD card installation

SD Card installation process

Raspberry-Pi foundation has released an easy way to set up SD card. It is NOOBS (New Out Of Box Software), which provides an easy way to install.

STEP1: Downloading and installing SD formatter
SD card formatter software has to be downloaded before using SD card further. SD card formatter is downloaded in the SD card which is connected to PC using a card reader.

STEP 2: Installing NOOBS on micro SD card
NOOBS is downloaded in the same way in the SD card.

STEP 3: Booting the Raspberry Pi
The SD card is placed in the slot provided in Raspberry-Pi. HDMA cable is connected and the power supply is given. NOOBS will run on the display screen. Connect it to WiFi and select the raspbian OS and now the programs can be coded using Python programming language and can be stored.

STEP 4: Server interaction
MQTT Message queuing telemetry transport protocol is a lightweight, low bandwidth and efficient protocol which is used to provide a simple communication between multiple devices. The server can publish the message with the topic name and the subscriber can use the same topic name to receive the information sent by the server.

3. RESULT

The electricity consumption is continuously monitored and amount of power theft is indicated by a message to the server. It can also monitor the electricity consumption through the smartphone.

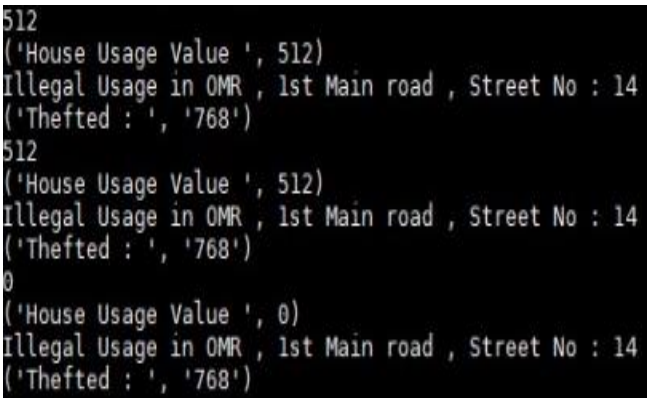

Fig.3.1. Status of electricity consumed

The water level in the tank is checked out and is filled periodically to a particular level with the help water level sensor. The measure of water level in the tank is indicated.

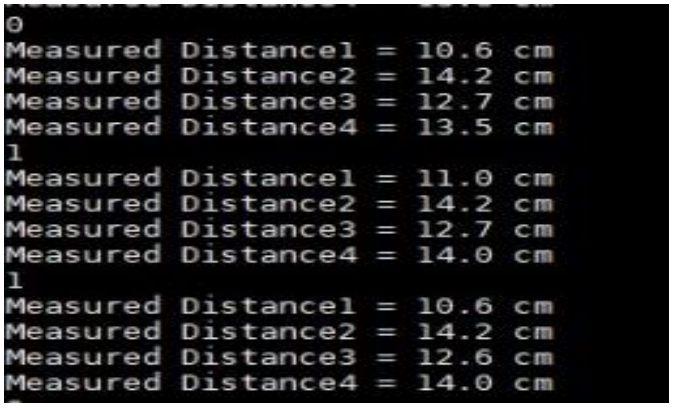

Fig.3.2. Status of water level

4. CONCLUSION AND FUTURE SCOPE

With improved tracking of devices using sensors and connectivity, they benefit from real-time insights and analytics using the Internet of Things. In the future implementation, smart electricity system can automatically shut down the power when anyone tried to theft and it can even send the status if any fault occurred in the transmission

line. Smart City can be designed with wide communicating infrastructure for unified and synchronized operation, to automate electricity and water distribution system.

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