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TANK LEVEL INDICATOR AUTOMATION AND INTELLIGENT SYSTEM FOR WASTE WATER MANAGEMENT

Dr. P. Lilly Florence[1], Dr. S. Richard Prabhu Gnanakan[2], Dr. B. Mary Juliet[3], K. Balamurugan[4], K. Nageswari Rosy[5], B. Jamal Mohamed Nasar[6] & R. Sujatha[7]

[1,2,3]Professor, Department of Chemistry, M.A.M. School of Engineering (AUTONOMOUS), Siruganur, Trichy - 6211052

[4,5,6,7]Assistant Professor, Department of Mathematics, M. A.M. School of Engineering (AUTONOMOUS), Trichy-6211052

ABSTRACT

Scarcity of water is one of the biggest issues revolving across the globe and water crisis is reaching the alarming level day by day. So, water conservation in one or the other way is gaining a significant importance. Mostly, now a days in urban as well as in rural areas water tank system is available. The biggest disadvantage of this system is the overflow of water from overhead tank and overrunning of water pump. Hence, in this work, it is tried to design an automatic water tank level and pump control system, which ensures several benefits. The sensor devices used in our system detects and controls the water level in the overhead tank and even in the pump. As per the level of water present in the overhead tank, the sensor senses the levels and sends different signals LORA transmitter, then the transmitter sends the signal to the receiver and the signals are used for switching ON and OFF the motor pump automatically as per requirements. The PIC microcontroller is used for controlling the overall process.

KEYWORDS: *Waste Water Management*

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INTRODUCTION

- In proposes a prototype system design, implementation and description of required tools and technologies to develop IoT-based water level monitoring system which can be implemented in future smart villages.
- It is necessary to manage water quality to fulfil the sustainability of water functions as a natural resource.
- They create an integrated system based on IoT to measure the water quality by developing environmental water management monitoring system using sensors.
- Also, a power efficient, simpler solution for in-tank water quality monitoring is based on IoT technology is presented.
- The model developed is used for testing water samples and the data uploaded over the Internet are analysed.
- The water wastage is because of numerous reasons, for example, inappropriate utilization of tank and pipes, leakages in tanks, administrator mistake and so forth. There is likewise issue of inconsistency of water supply.

- Water flow control is unimaginable. The water supply scheme is a piece of the urban foundation which must guarantee the proper water distribution, water quality control and examination. In existing framework as appeared in figure 1, urban water is provided to the habitats with the assistance of labor.
- The individual in control will go to the place and afterward open the valve to that specific territory. Once the time is over the individual will go again to that place and close the valve. This sort of activity needs labor. This is exercise in futility to go to that place and rebound frequently.
- Likewise the general population may take overabundance water for their own utilization with the assistance of engine or some other hardware. Because of this numerous individuals won't get adequate water for their utilization. Water is the fundamental needs of the people. The theft can be counteracted just when any public educate the authorities about the theft. So, the chances of public educating to higher officers are rare.

METHODOLOGY

- The elementary design of this manuscript is to build a scheme for legitimate water appropriation framework, which can distribute water to the habitats. For such kind of water dispersion, it is important to have an appropriate dissemination design with the end goal that it can do the trick the essential necessities of the habitats.
- As the fundamental goal of our task is to have a framework which can achieve the habitats their essential need of water, with legitimate amount, time and to buy the water at required quantity by utilizing an android application. To switch ON/OFF the solenoid valve the relay circuit is used. The relay circuit is triggered by the Arduino.
- If the switch is turned on in the Blink application the solenoid valve is opened and water is supplied to the habitat tank for a fixed duration and after that water supply is automatically stopped.
- The habitats of rural/urban area can get the additional amount of water rather than actual interval allotted to the entire area, can be delivered using the selector switch which is fixed for that particular habitat.

PROBLEM STATEMENT

- Wired connection is existed and damage in wire increases.
- Proper response in speed is slow

EXISTING SYSTEM

- A water level sensor is placed inside the water tank.
- The yield of the sensors is to send to microcontroller which gives the information about the status of the water level in the tank.
- The connection exists between the tank and the motor through wire and there will be a damage in wire because of continuous usage. So we go for the proposed method.

DESCRIPTION OF PROPOSED METHODS

- PV panel is used as the voltage source for transmitter side.
- Pic microcontroller is used to control the overall process.

- Water level sensor is used measure the level of water in the tank.
- Once the water level is low or high, the transmitter sends the information to the receiver which is connected to the motor starter.
- So automatically, the motor starts / stops once the signal received from transmitter.
- 5V DC is designed using step-down transformer and voltage regulator.
- Receiver is connected to the controller.
- Once the Signal is received from transmitter, the receiver receives the signal and conveys to the controller.
- The controller switches on/ off the motor accordingly the signal like the water level is high or low.

BLOCK DIAGRAM (TRANSMITTER SIDE)

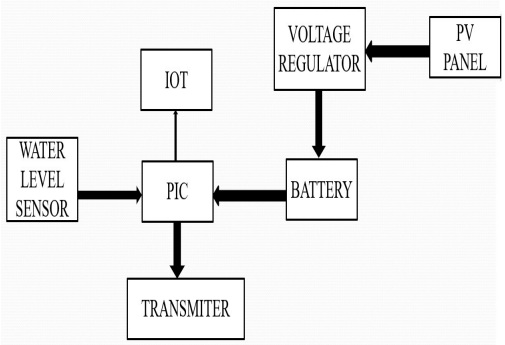

Figure 1

BLOCK DIAGRAM (RECEIVER SIDE)

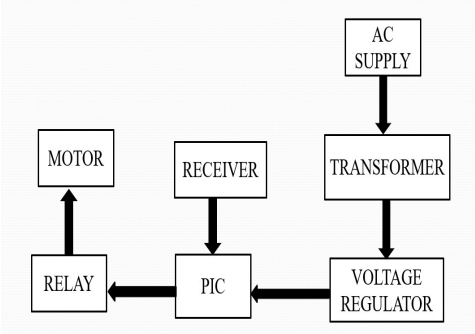

Figure 2

WATER LEVEL SENSOR

The water level sensor is a device that measures the liquid level in a fixed container that is too high or too low. According to the method of measuring the liquid level, it can be divided into two types: contact type and non-contact type. The input type water level transmitter we call is a contact measurement, which converts the height of the liquid level into an electrical signal for output. It is currently a widely used water level transmitter.

The working principle of the water level sensor is that when it is put into a certain depth in the liquid to be measured, the pressure on the sensor's front surface is converted into the liquid level height. The calculation formula is $P=\rho.g.H+Po$, in the formula P is the pressure on the liquid surface of the sensor, ρ is the density of the liquid to be measured, g is the local acceleration of gravity, Po is the atmospheric pressure on the liquid surface, and H is the depth at which the sensor drops into the liquid.

The optical sensor is solid-state. They use infrared LEDs and phototransistors, and when the sensor is in the air, they are optically coupled. When the sensor head is immersed in the liquid, the infrared light will escape, causing the output to change. These sensors can detect the presence or absence of almost any liquid. They are not sensitive to ambient light, are not affected by foam when in air, and are not affected by small bubbles when in liquid. This makes them useful in situations where state changes must be recorded quickly and reliably, and in situations where they can operate reliably for long periods without maintenance. Capacitance level switches use 2 conductive electrodes (usually made of metal) in the circuit, and the distance between them is very short. When the electrode is immersed in the liquid, it completes the circuit. Can be used to determine the rise or fall of the liquid in the container. By making the electrode and the container the same height, the capacitance between the electrodes can be measured. No capacitance means no liquid. A full capacitance represents a complete container. The measured values of "empty" and "full" must be recorded, and then 0% and 100% calibrated meters are used to display the liquid level. The tuning fork level gauge is a liquid point level switch tool designed by the tuning fork principle. The working principle of the switch is to cause its vibration through the resonance of the piezoelectric crystal. The diaphragm or pneumatic level switch relies on air pressure to push the diaphragm, which engages with a micro switch inside the main body of the device. As the liquid level increases, the internal pressure in the detection tube will increase until the micro switch is activated. As the liquid level drops, the air pressure also drops, and the switch opens. The float switch is the original level sensor. They are mechanical equipment. The hollow float is connected to the arm. As the float rises and falls in the liquid, the arm will be pushed up and down. The arm can be connected to a magnetic or mechanical switch to determine on/off, or it can be connected to a level gauge that changes from full to empty when the liquid level drops.

The use of float switches for pumps is an economical and effective method to measure the water level in the pumping pit of the basement.

The ultrasonic level gauge is a digital level gauge controlled by a microprocessor. In the measurement, the ultrasonic pulse is emitted by the sensor (transducer). The sound wave is reflected by the liquid surface and received by the same sensor. It is converted into an electrical signal by a piezoelectric crystal.

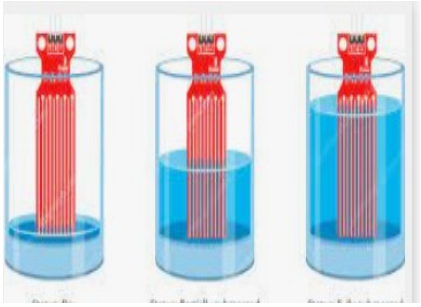

Figure 3

IOT

The Internet of things (IoT) describes physical objects (or groups of such objects) with sensors, processing ability, software, and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks. Internet of things has been considered a misnomer because devices do not need to be connected to the public internet, they only need to be connected to a network and be individually addressable. The field has evolved due to the convergence of multiple technologies, including ubiquitous computing, commodity sensors, increasingly powerful embedded systems, and machine learning. Traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), independently and collectively enable the Internet of things. In the consumer market, IoT technology is most synonymous with products pertaining to the concept of the "smart home", including devices and appliances (such as lighting fixtures, thermostats, home security systems, cameras, and other home appliances) that support one or more common ecosystems, and can be controlled via devices associated with that ecosystem, such as smartphones and smart speakers. IoT is also used in healthcare systems.

There are a number of concerns about the risks in the growth of IoT technologies and products, especially in the areas of privacy and security, and consequently, industry and governmental moves to address these concerns have begun, including the development of international and local standards, guidelines, and regulatory frameworks.

IoT applications run on IoT devices and can be created to be specific to almost every industry and vertical, including healthcare, industrial automation, smart homes and buildings, automotive, and wearable technology. Increasingly, IoT applications are using AI and machine learning to add intelligence to devices.

IoT devices contain sensors and mini-computer processors that act on the data collected by the sensors via machine learning. Essentially, IoT devices are mini computers, connected to the internet, and are vulnerable to malware and hacking.

- Smart Homes.
- Smart City.
- Self-driven Cars.
- IoT Retail Shops.
- Farming.
- Wearable.
- Smart Grids.
- Industrial Internet.

The future of IoT has the potential to be limitless. Advances to the industrial internet will be accelerated through increased network agility, integrated artificial intelligence (AI) and the capacity to deploy, automate, orchestrate and secure diverse use cases at hyper scale.

PIC

PIC microcontrollers (Programmable Interface Controllers), are electronic circuits that can be programmed to carry out a vast range of tasks. They can be programmed to be timers or to control a production line and much more.

PICs have a set of registers that function as general-purpose RAM. Special-purpose control registers for on-chip hardware resources are also mapped into the data space. The addressability of memory varies depending on device series, and all PIC device types have some banking mechanism to extend addressing to additional memory (but some device models have only one bank implemented). Later series of devices feature move instructions, which can cover the whole addressable space, independent of the selected bank. In earlier devices, any register move must be achieved through the accumulator. The code space is generally implemented as on-chip ROM, EPROM or flash ROM. In general, there is no provision for storing code in external memory due to the lack of an external memory interface. The exceptions are PIC17 and select high pin count PIC18 devices. All PICs handle (and address) data in 8-bit chunks. However, the unit of addressability of the code space is not generally the same as the data space. For example, PICs in the baseline (PIC12) and mid-range (PIC16) families have program memory addressable in the same word size as the instruction width, i.e. 12 or 14 bits respectively. In contrast, in the PIC18 series, the program memory is addressed in 8-bit increments (bytes), which differs from the instruction width of 16 bits.

In order to be clear, the program memory capacity is usually stated in number of (single-word) instructions, rather than in bytes. The architectural decisions are directed at the maximization of speed-to-cost ratio. The PIC architecture was among the first scalar CPU designs and is still among the simplest and cheapest. The Harvard architecture, in which instructions and data come from separate sources, simplifies timing and microcircuit design greatly, and this benefits clock speed, price, and power consumption. PIC microcontrollers are based on the Harvard architecture where program and data busses are kept separate. Early versions of PIC microcontrollers use EPROM to store the program instruction but have adopted the flash memory since 2002 to allow better erasing and storing of the code. They are reliable and malfunctioning of PIC percentage is very less. And performance of the PIC is very fast because of using RISC architecture. Power conception is also very less when compared to other micro controllers.PIC 16F877 series normally has five input/output ports. They are used for the input/output interfacing with other devices/circuits. Most of these port pins are multiplexed for handling alternate function for peripheral features on the devices. All ports in a PIC chip are bi-directional.

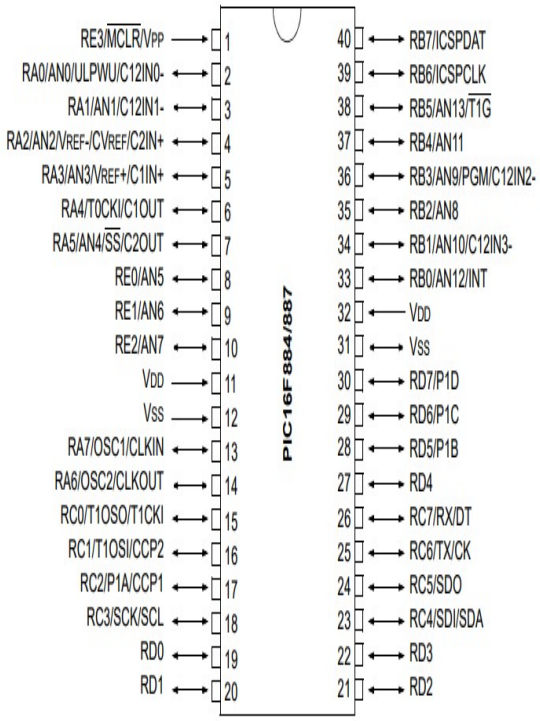

Figure 4

BATTERY

A battery is a device that stores chemical energy and converts it to electrical energy. The chemical reactions in a battery involve the flow of electrons from one material (electrode) to another, through an external circuit. The flow of electrons provides an electric current that can be used to do work. Common specifications include the type of cell the battery is in, its standard voltage, its mAH rating, its standard charge (for rechargeable), and its rapid charge (for rechargeable). There are some other types of Secondary Batteries but the four major types are: Lead – Acid Batteries. Nickel – Cadmium Batteries. Nickel – Metal Hydride Batteries. Lithium – Ion Batteries. Despite its name, electromotive force is not actually a force. It is commonly measured in units of volts, equivalent in the metre–kilogram–second system to one joule per coulomb of electric charge. electric battery is a source of electric power consisting of one or more electrochemical cells with external connections[1] for powering electrical devices.

When a battery is supplying power, its positive terminal is the cathode and its negative terminal is the anode.[2] The terminal marked negative is the source of electrons that will flow through an external electric circuit to the positive terminal. When a battery is connected to an external electric load, a redox reaction converts high-energy reactants to lower-energy products, and the free-energy difference is delivered to the external circuit as electrical energy. Historically the term "battery" specifically referred to a device composed of multiple cells; however, the usage has evolved to include devices composed of a single cell.

Primary (single-use or "disposable") batteries are used once and discarded, as the electrode materials are irreversibly changed during discharge; a common example is the alkaline battery used for flashlights and a multitude of portable electronic devices. Secondary (rechargeable) batteries can be discharged and recharged multiple times using an

applied electric current; the original composition of the electrodes can be restored by reverse current. Examples include the lead-acid batteries used in vehicles and lithium-ion batteries used for portable electronics such as laptops and mobile phones.

Batteries come in many shapes and sizes, from miniature cells used to power hearing aids and wristwatches to, at the largest extreme, huge battery banks the size of rooms that provide standby or emergency power for telephone exchanges and computer data centres.

Batteries have much lower specific energy (energy per unit mass) than common fuels such as gasoline. In automobiles, this is somewhat offset by the higher efficiency of electric motors in converting electrical energy to mechanical work, compared to combustion engines.

TRANSMITTER

A transmitter is an electronic device used in telecommunications to produce radio waves in order to transmit or send data with the aid of an antenna. The transmitter is able to generate a radio frequency alternating current that is then applied to the antenna, which, in turn, radiates this as radio waves. There are many types of transmitters depending on the standard being used and the type of device. Transmitters are devices that are used to send out data as radio waves in a specific band of the electromagnetic spectrum in order to fulfil a specific communication need, be it for voice or for general data. In order to do this, a transmitter takes energy from a power source and transforms this into a radio frequency alternating current that changes direction millions to billions of times per second depending on the band that the transmitter needs to send in. When this rapidly changing energy is directed through a conductor, in this case an antenna, electromagnetic or radio waves are radiated outwards to be received by another antenna that is connected to a receiver that reverses the process to come up with the actual message or data.

A transmitter is composed of:

- Power supply — The energy source used to power the device and create the energy for broadcasting
- Electronic oscillator — Generates a wave called the carrier wave where data is imposed and carried through the air
- Modulator — Ads the actual data into the carrier wave by varying some aspect of the carrier wave
- RF amplifier — Increases the power of the signal in order to increase the range where the waves can reach
- Antenna tuner or impedance matching circuit — Matches the impedance of the transmitter to that of the antenna in order for the transfer of power to the antenna to be efficient and prevent a condition called standing waves, where power is reflected from the antenna back to the transmitter, wasting power or damaging it

VOLTAGE REGULATOR

The LM7805 is a voltage regulator that outputs +5 volts. Like most other regulators in the market, it is a three-pin IC; input pin for accepting incoming DC voltage, ground pin for establishing ground for the regulator, and output pin that supplies the positive 5 volts.

- 3-Terminal Regulators
- Output Current up to 1.5A
- Internal Thermal-Overload Protection
- High Power-Dissipation Capability
- Internal Short-Circuit Current Limiting
- Output Transistor SAFE-Area Compensation

Turn on the DC power supply and adjust the output voltage of about 8V or slightly larger. Or alternatively you can use a battery 9V-12V as voltage source. Look at the voltmeter panel when you set the voltage. Prepare a DC voltmeter readings on voltage range 50V to measure the output voltage of the IC 7805.These are used in various electronic circuits to provide a stable o/p voltage for a different i/p voltage. So this IC can be used in most of the electronic projects. In this IC, 78 signifies a +ve voltage regulator whereas 05 signifies 5V output voltage.

Figure 5

PANEL

- A solar cell panel, solar electric panel, photo-voltaic (PV) module or solar panel is an assembly of photo-voltaic cells mounted in a framework for installation. Solar panels use sunlight as a source of energy to generate direct current electricity. A collection of PV modules is called a PV panel, and a system of PV panels is called an array. Arrays of a photovoltaic system supply solar electricity to electrical equipment.
- A single solar module can produce only a limited amount of power; most installations contain multiple modules adding voltages or current to the wiring and PV system. A photovoltaic system typically includes an array of photovoltaic modules, an inverter, a battery pack for energy storage, charge controller, interconnection wiring, circuit breakers, fuses, disconnect switches, voltage meters, and optionally a solar tracking mechanism. Equipment is carefully selected to optimize output, energy storage, reduce power loss during power transmission, and conversion from direct current to alternating current.
- Solar inverters convert the DC power to AC power by performing the process of maximum power point tracking (MPPT): solar inverter samples the output Power (I-V curve) from the solar cell and applies the proper resistance (load) to solar cells to obtain maximum power.
- MPP (Maximum power point) of the solar panel consists of MPP voltage (V mpp) and MPP current (I mpp): it is a capacity of the solar panel and the higher value can make higher MPP.

Solar panels are wired to inverters in parallel or series (a 'string'). In string connections the voltages of the modules add, but the current is determined by the lowest performing panel. This is known as the "Christmas light effect".

In parallel connections the voltages must be the same to work, but currents add. Arrays are connected up to meet the voltage requirements of the inverters and to not greatly exceed the current limits.

Micro-inverters work independently to enable each panel to contribute its maximum possible output for a given amount of sunlight, but can be more expensive.

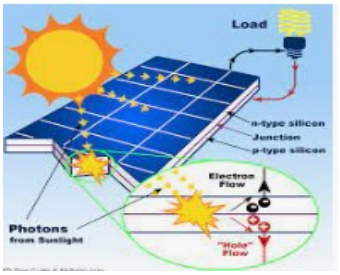

Figure 6

RECEIVER

The receiver in information theory is the receiving end of a communication channel. It receives decoded messages/information from the sender, who first encoded them. Sometimes the receiver is modelled so as to include the decoder. The term receiver, however, is mostly used in communication, specifically wireless communication in terms of networking and cellular communication. It is the device that receives and decodes signals and then conditions or transforms them into something that another machine or computer understands.

RELAY

- Relay works on the principle of electromagnetic induction.
- When the electromagnet is applied with some current, it induces a magnetic field around it.
- Above image shows working of the relay. A switch is used to apply DC current to the load.
- In the relay, Copper coil and the iron core acts as electromagnet.
- When the coil is applied with DC current, it starts attracting the contact as shown. This is called energizing of relay.
- When the supply is removed it retrieves back to the original position. This is called De energizing of relay.

There are also such relays, whose contacts are initially closed and opened when there is supply .Relays are used to protect the electrical system and to minimize the damage to the equipment connected in the system due to over currents/voltages. The relay is used for the purpose of protection of the equipment connected with it. These are used to control the high voltage circuit with low voltage signal in applications audio amplifiers and some types of modems. These are used to control a high current circuit by a low current signal in the applications like starter solenoid in automobile. These can detect and isolate the faults that occurred in power transmission and distribution system. Typical application areas of the relays include.

- Lighting control systems
- Telecommunication
- Industrial process controllers
- Traffic control
- Motor drives control
- Protection systems of electrical power system
- Computer interfaces
- Automotive
- Home appliances

Figure 7

TRANSFORMER

A transformer is a device used in the power transmission of electric energy. The transmission current is AC. It is commonly used to increase or decrease the supply voltage without a change in the frequency of AC between circuits. The transformer works on basic principles of electromagnetic induction and mutual induction. Commonly used transformer type, depending upon voltage they are classified as:

- **Step-up Transformer:** They are used between the power generator and the power grid. The secondary output voltage is higher than the input voltage.
- **Step down Transformer:** These transformers are used to convert high voltage primary supply to low voltage secondary output.

The transformer works on the principle of Faraday's law of electromagnetic induction and mutual induction. There are usually two coils primary coil and secondary coil on the transformer core. The core laminations are joined in the form of strips. The two coils have high mutual inductance. When an alternating current pass through the primary coil it creates a varying magnetic flux. As per faraday's law of electromagnetic induction, this change in magnetic flux induces an emf (electromotive force) in the secondary coil which is linked to the core having a primary coil. This is mutual induction.

The core acts as a support to the winding in the transformer. It also provides a low reluctance path to the flow of magnetic flux. The winding is wound on the core as shown in the picture. It is made up of a laminated soft iron core in order to reduce the losses in a transformer. The factors such as operating voltage, current, power etc decide core composition. The core diameter is directly proportional to copper losses and inversely proportional to iron losses. Windings are the set of copper wires wound over the transformer core. Copper wires are used due to:

- The high conductivity of copper minimizes the loss in a transformer because when the conductivity increases, resistance to current flow decreases.
- The high ductility of copper is the property of metals that allows it to be made into very thin wires. There are mainly two types of windings. Primary windings and secondary windings. Primary winding: The set of turns of windings to which supply current is fed. Secondary winding: The set of turns of winding from which output is taken The primary and secondary windings are insulated from each other using insulation coating agents.

Ideal Transformer

The ideal transformer has no losses. There is no magnetic leakage flux, ohmic resistance in its windings and no iron loss in the core.

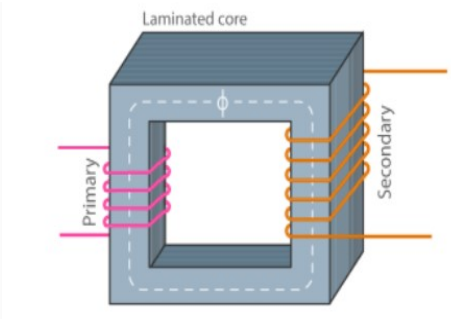

Figure 8

AC SUPPLY

Alternating current (**AC**) is an electric current which periodically reverses direction and changes its magnitude continuously with time in contrast to direct current (DC) which flows only in one direction. Electrical energy is distributed as alternating current because AC voltage may be increased or decreased with a transformer. This allows the power to be transmitted through power lines efficiently at high voltage, which reduces the energy lost as heat due to resistance of the wire, and transformed to a lower, safer, voltage for use. Use of a higher voltage leads to significantly more efficient transmission of power. The power losses ({\displaystyle P_{\rm {w}}}in the wire are a product of the square of the current (I) and the resistance (R) of the wire, described by the formula:{\displaystyle P_{\rm {w}}=I^{2}R\,.}

This means that when transmitting a fixed power on a given wire, if the current is halved (i.e. the voltage is doubled), the power loss due to the wire's resistance will be reduced to one quarter. The power transmitted is equal to the product of the current and the voltage (assuming no phase difference); that is, Consequently, power transmitted at a higher voltage requires less loss-producing current than for the same power at a lower voltage. Power is often transmitted at hundreds of kilovolts on pylons, and transformed down to tens of kilovolts to be transmitted on lower level lines, and finally transformed down to 100 V – 240 V for domestic use. Three-phase high-voltage transmission lines use alternating currents to distribute power over long distances between electric generation plants and consumers. The use of lower frequencies also provided the advantage of lower impedance losses, which are proportional to frequency. The original Niagara Falls generators were built to produce 25 Hz power, as a compromise between low frequency for traction and heavy induction motors, while still allowing incandescent lighting to operate

RESULT ANALYSIS

- In this section, the results obtained from the analysis is carried out on the architecture and prototype of the solution as described.
- We used to pic controller controlling the setup and sensor values are measured water level.
- The motor drive on /off performance based on transmitter signal.

CONCLUSION

- This work developed and tested architecture for IoT systems for efficient and scalable monitoring of water resources.
- Thus the automation of motor on/off and water tank level is achieved using embedded technology.

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