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Different Technology and Algorithms used in An Intelligent,Smart Water Management System: A survey

Nidhi Mishra, Dr. Sanjay Mohite
Research Scholar, JJTU
Assistant Professor, BSIOTR,
Pune

ABSTRACT: Water is one of the vital resources for human life. The dramatic change in climate and increase in the population made water insufficient compared to demand. Smart water management is a system that collects meaningful and usable data about a city's water flow, pressure, and distribution. Its primary objective is to ensure that the infrastructure and energy utilized to transport water are effectively controlled. Pressure control, improved leakage strategies for water networks, and smart nets are some of the most important aspects of water management. The basic goal of smart water management is to use and recycle water resources in a fair and sustainable manner. Water is becoming an even more valuable resource due to rising population, environmental concerns, and strain on the food and agriculture sectors. Conventional water and wastewater systems can be transformed into instrumented, interconnected, and intelligent systems using smart technologies. The ability to detect, sense, measure, and record data is known as instrumentation. The ability to communicate and interact with system operators and managers is interconnected.
Intelligent means the capacity to assess a situation, respond quickly, and optimize troubleshooting solutions.

IndexTerms – **Internet of Things, Machine Learning , Sensors, Water meter ,Smart City**.

I. Introduction

Water management policies must also about ensuring sufficient water to produce the energy demanded by society. Humans and their economies and societies critically depend on reliable supplies of energy.

Energy, as electricity and liquid and gaseous fuels, available when and where needed, requires water to produce, such as for cooling and refining. Water, of sufficient quality and pressure, available when and where needed, requires energy to produce. In short, energy is needed to provide much of the water we need and use, and water is needed to provide most of the energy we need and use. How can we ensure enough of both to meet all future water and energy demands? Limitations of either can constrain future economic and social development as well as adversely impact human and environmental health. The global population in 2050 is expected to be two billion more than it is today[1].

Fig:1 Smart Water Management

II. SMART WATER MANAGEMENT TECHNOLOGIES

A. Sensor Networks

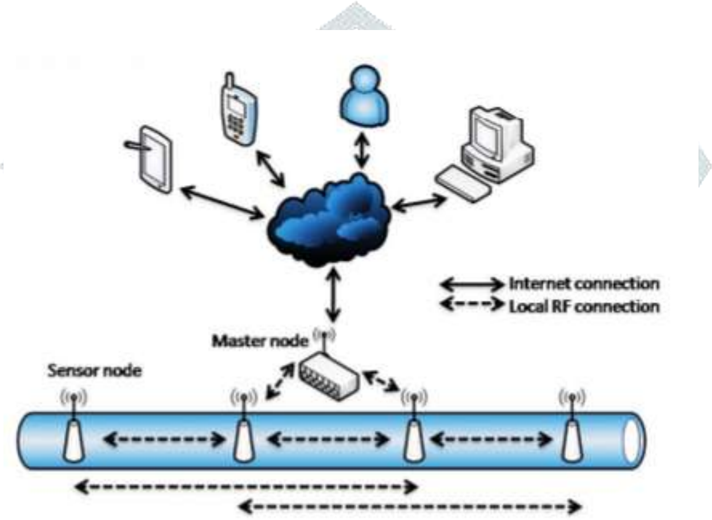

Fig.2.Scheme of a smart wireless sensor network
(Sadeghioon et al.,2014)

A sensor network is a group of sensors, where each sensor monitors data from different locations and sends the data to a central location for storage, display, and analysis. A single sensor node generally has four main parts: data acquisition and processing unit, transmission unit, power supply management, and sensors. Each part performance has a major impact on power consumption and reliability affects the overall performance of the sensor and network[2].

B. SMART WATER METERING

The water meter is a device used to measure the water consumption in a building, while the smart water meter is a metering device, which has the ability to frequently store and transmit water consumption data . Sometimes smart metering is called "use time m3 ", because in addition to measuring the volume consumed, also records the date and time when consumption occurred.

Fig.3.Scheme of a smart meter

C. GEOGRAPHIC INFORMATION SYSTEM – GIS

Regarding the implementation of the Geographic Information System (GIS), it should be understood that this tool can be applied to various research fields. When applied to intelligent water management technology, let us have a clearer understanding of

Its evolution. The main advantage of GIS is the modulation of reality based on data, and they play an important role in today's society, because they are information systems, which are designed to collect, design, store, receive, share. , operate, analyze and present information [3].

D. SUPERVISORY CONTROL AND DATA ACQUISITION – SCADA

Generally speaking, most public water supply services have started online monitoring, in which the supervision, control and management of data is completed through a system called SCADA (Supervisory Control and Control). Data Acquisition) (EPA, 2009).

In this way, SCADA is a system that allows operators to change the set point on the remote process controller in the center of in a widely distributed process, to open or close valves or switches in to monitor alarms and Collect measurement information.

E. CLOUD COMPUTING

The concept of cloud computing refers to the use and calculation of the memory and storage capacity of computers and servers that are shared and linked via the Internet following the principle of network computing. data is stored on the server, and can be accessed from anywhere in the world and at any time, without the need to install programs or store data on other devices. Access to programs, services, and files is remote, via the Internet therefore implies the cloud. Using this type is more feasible than using physical drives[6].

F.LoRa

LoRa employs a star-of-stars topology, in which gateways serve as transparent bridges between end-devices and a backend network server. End-devices use single-hop wireless communication to one or more gateways, while gateways are connected to the network server via wired or wireless connections. Several distinct protocols are used to communicate between different end-devices and gateways.

III. Water quality monitoring

The Five Basic Water Quality Parameters:

These can be harmed in a variety of ways. The five parameters listed below are essential for aquatic life. Impacts on the flora and fauna of a certain water body can be seen as a result of these impairments.

1. Dissolved Oxygen

Fig.3.Dissolved oxygen

It refers to how much oxygen is dissolved in water. To survive and flourish, most aquatic species require oxygen.

Catfish, worms, and dragonflies, for example, do not require high dissolved Oxygen levels. The following can happen if there isn't enough oxygen in the water:

1.Adults and juveniles have died.

2. Growth is slowing.

2. Temperature

The average energy (kinetic) of water molecules is measured by temperature. It's measured in degrees Celsius or Fahrenheit on a linear scale.It's one of the most crucial aspects of water quality. The chemistry of water and the functions of aquatic life are both affected by temperature.

It affects the amount of oxygen that can be dissolved in water, the rate of photosynthesis by algae and other aquatic plants, the metabolic rates of creatures, their sensitivity to toxic wastes, parasites, and illnesses, and the timing of aquatic organisms' reproduction, migration, and aestivation.

3. Electrical Conductivity/Salinity

The amount of salts in the water is measured by salinity. The two measurements are linked because dissolved ions enhance both salinity and conductivity. Sodium chloride is the most common salt found in seawater (NaCl). The quality of water used for irrigation or drinking is affected by salts and other contaminants. They also have a significant impact on aquatic biota, and each organism has a certain salinity tolerance range. Furthermore, the water's ionic composition can be crucial. Cladocerans (water fleas), for example, are significantly more susceptible to potassium chloride than sodium chloride at the same concentration.

4.pH

The term pH comes from the French "puissance d'Hydrogène," which means "strong of hydrogen" and refers to how acidic or basic (alkaline) the water is. The negative log of the hydrogen ion concentration.

The pH scale ranges from 0 to 14 on a logarithmic scale. The hydrogen ion concentration falls tenfold with each whole number increment (i.e. 1 to 2), thus the water becomes less acidic.

Water becomes increasingly acidic as the pH drops. The pH of water rises as it becomes more basic.

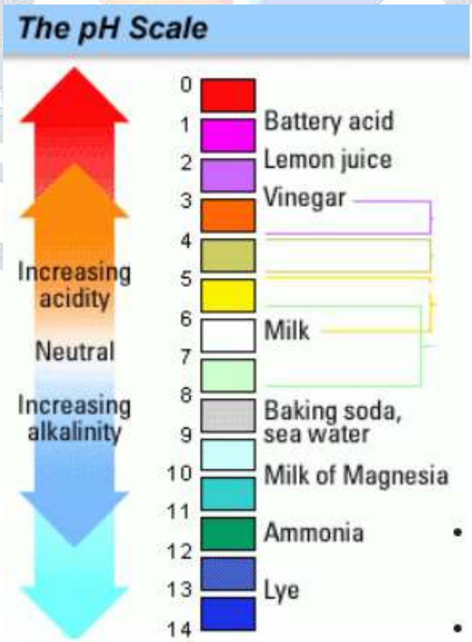

Fig.4.pH scale

A restricted pH range is required for several chemical reactions inside aquatic organisms (cellular metabolism), which are important for survival and growth.Physical damage to gills, exoskeleton, and fins occurs at the extreme extremities of the pH scale (2 or 13).

Changes in pH may cause other compounds in water to revert to a more hazardous state. A drop in pH (below 6) may increase the quantity of mercury soluble in water, for example. The conversion of benign ammonia (ammonium ion) to a hazardous form of ammonia is accelerated when the pH rises over 8.5. (un-ionized ammonia).

5. Turbidity

The amount of suspended particles in the water is measured by turbidity. Algae, suspended sediment, and organic matter particles can turbinate water by clouding it.

Suspended particles absorb heat and disperse sunlight. As a result, the temperature rises and the amount of light available for algae photosynthesis decreases. If the turbidity is produced by suspended silt, it could be a sign of natural or man-made erosion. The gills of fish can become clogged by suspended particles. The material can dirty gravel beds and suffocate fish eggs and benthic insects as it settles. Pathogens, contaminants, and nutrients can all be carried in the sediment.

IV .Optimization Techniques

a)Genetic algorithm

A **genetic algorithm** is a search heuristic that is inspired by Charles Darwin's theory of natural evolution. This algorithm reflects the process of natural selection where the fittest individuals are selected for reproduction in order to produce offspring of the next generation**.**

Five phases are considered in a genetic algorithm.

1.Initial population

2.Fitness function

3.Selection

4.Crossover

5.Mutation

Flow Chart

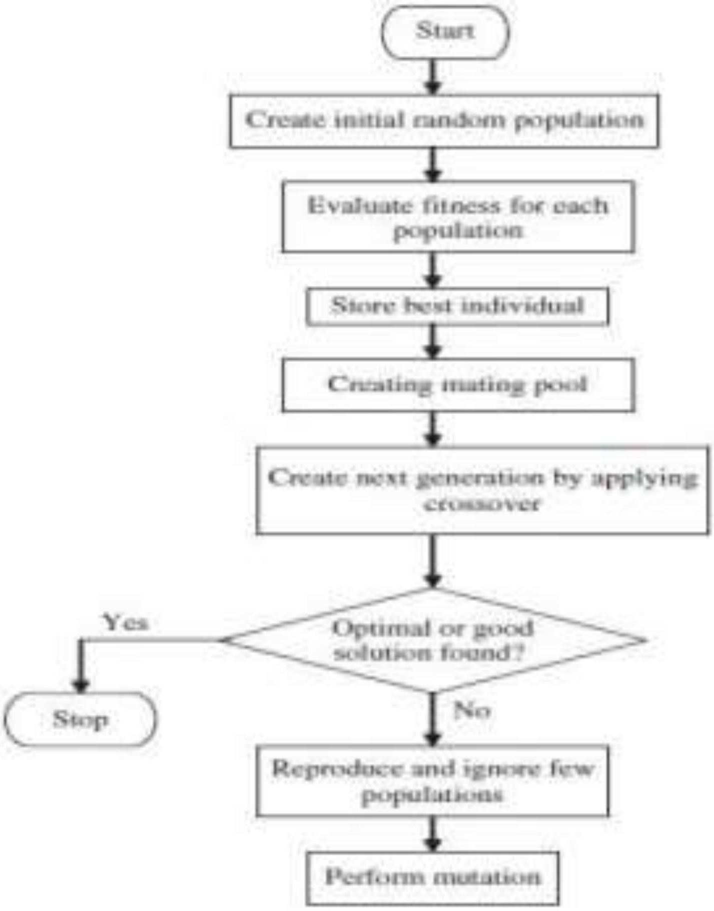

Fig.3.Flowchart of GA

PSO algorithm proposed by Eberhart & Kennedy (1995) is a population-based meta-heuristic search technique that uses co-operative group intelligence concepts. Here the particle denotes individual in a swarm. Each particle in a swarm behaves in a distributed way using its own or cognitive intelligence and the collective or social (group) intelligence of the swarm. As such, if one particle discovers a good path to food, the rest of the swarm will also be able to follow the good path instantly even if their location is far away in the swarm. PSO shares many similarities with GA (Kumar & Reddy 2007). PSOs are initialized with a population of random solutions and searches for optima by updating iterations.

Flow Chart

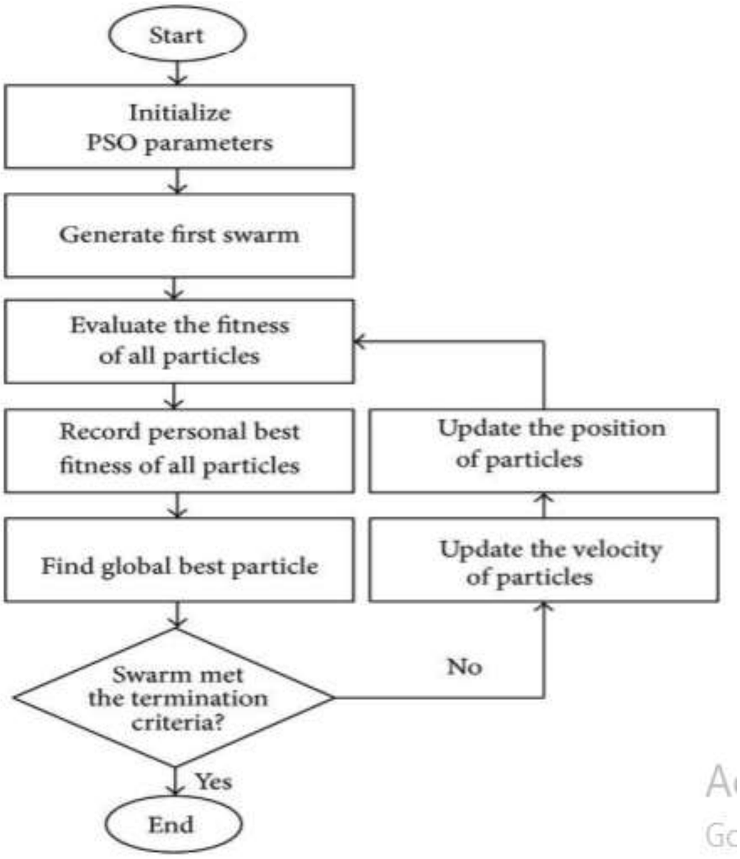

Fig.3.Flowchart of PSO

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