

A Smart Environment Monitoring System Using Internet of Things (IOT)

Abstract:-

In recent decades, the science and engineering professions have been heavily influenced by their responsibilities to the society. This responsibility has been directed towards the protection of public health and welfare.

In devising controls for emission of pollutants, scientists and engineers have developed strategies for monitoring the environmental pollution problems.

Environmental monitoring IT describes the processes and activities that need to take place to monitor the quality of the environment.

In this paper, I have proposed an idea to monitor pollution using IOT Techniques. The extent to which the environment gets affected is noted and corresponding control and prevention practices are implemented.

Introduction:-

Health and hygiene are key components of the sustainability of mankind and progress of any country, which comes from a clean, pollution free and hazardous free environment. Thus, its monitoring becomes essential so as to ensure that the citizens of any nation can lead a healthy life.

Proper planning and management of disasters, controlling different pollutions and also associated challenges are a part of Environment monitoring (EM). EM deals with water pollution, air pollution, hazardous radiation, weather changes, earthquake events, etc.

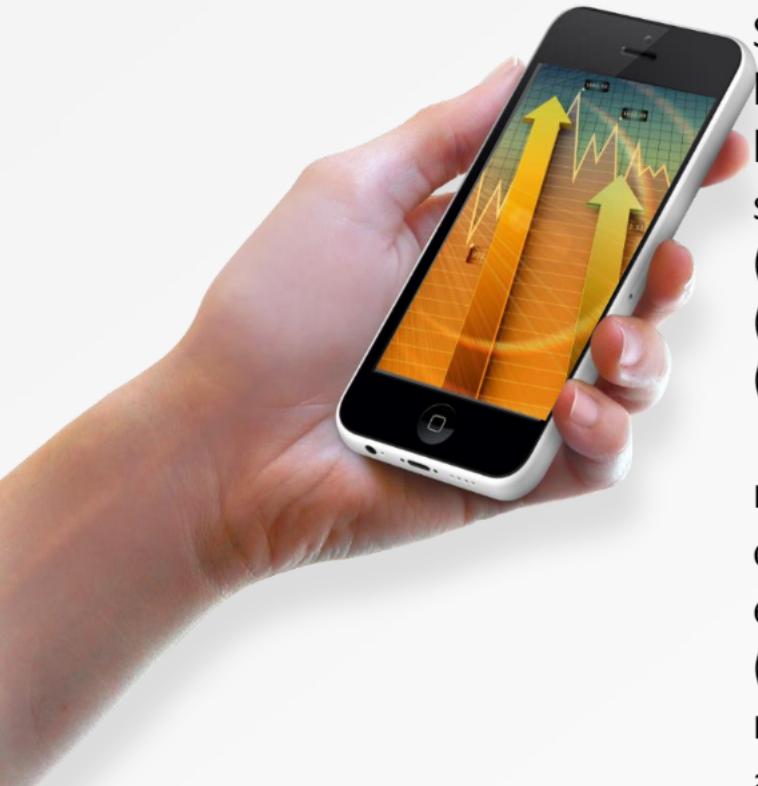
Recent advances in science and technology, especially artificial intelligence (AI) and machine learning, EM has become a smart environment monitoring (SEM) system.

The balance of the natural atmosphere has been disrupted due to excessive industrialization and urbanization which is causing the reduction of air quality and resulting in serious damage for citizens health. As a result , it is crucial to monitor air quality to protect and improve the life quality of citizens.

Technology using IoT

- 1.) IoT is a new generation of the internet that allows linking many devices and sensors of various technologies. IOT allows the design of distributed and fairly intelligent systems, making us able to handle our appliances remotely and without any displacement.
- 2.) IOT is also tightly mixed with many aspects of the smart cities concepts (traffic management, health care,. .). IOT is as well increasingly used by researchers to monitor air quality, detect high levels of pollution over time and define actions to perform.
- 3.) The major application of wireless sensor network is environment monitoring. WSN consists of different sensors which are widely distributed to monitor different environment parameters like temperature, humidity, gases, pressure , wind speed etc.
- 4.) The current study on advances in IoT and sensor technologies used for SEM provides insight to the scientists, policymakers, and researchers in developing a framework of appropriate methods for monitoring the environment that faces challenges mainly due to poor air quality, water pollution and radiation.

Some of the Research Projects based on IOT



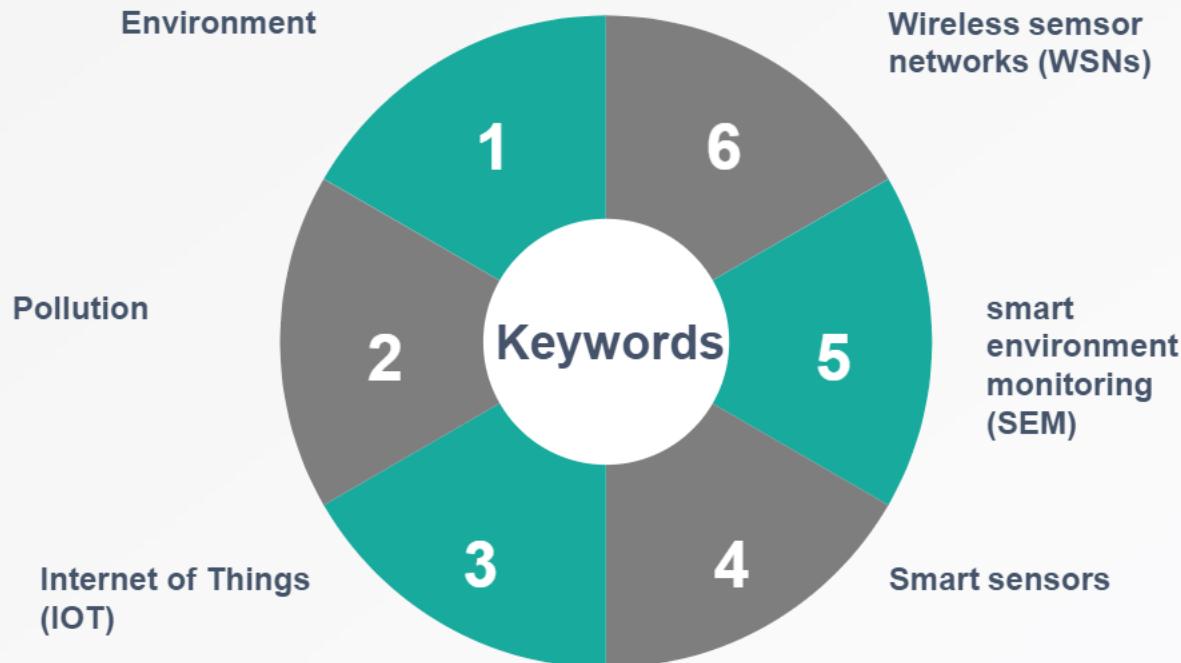
There are a huge number of contributions on SEM based on purposes and types of methods, have been studied and therefore the related research has been discussed in three main subsections, namely the study based on smart agriculture monitoring systems (SAMs), smart water pollution monitoring systems (SWPMs), and smart air quality monitoring systems (SAQMs).

The major findings and limitations of the current research on SEM which includes Soil monitoring (SM) ocean environment monitoring (OEM), marine environment monitoring (MEM), air quality monitoring (AQM), water quality monitoring (WQM) and radiation monitoring (RM) have been covered, by offering a wide analysis of different application fields of SEM.

Research studies based on purpose and applications of environment monitoring.

Research	Purpose	Findings and Challenges	Method/Device Used
OEM	Oceanic environment monitoring	Light weight; costly and invasive sensory networks	Wireless Sensors
IOT Based SM	Soil monitoring for farming	Greenhouse gases pose challenges on health of vegetables like tomato	Wireless sensors
IoT for air pollution	Air pollution monitoring system	Mobile kit for prediction, low sensitivity	Gas sensor and IoT
IoT based SEM	Environmental monitoring	interoperability issues of heterogeneous sensors	Heterogeneous sensors
Air quality	Air quality monitoring	Large area monitoring; noisy data	Geomatics sensors and IoT
Pollution	Air pollution	Real time monitoring;	Sensors with MQ3

Keywords:-



Study based on Smart Agriculture (SAM)

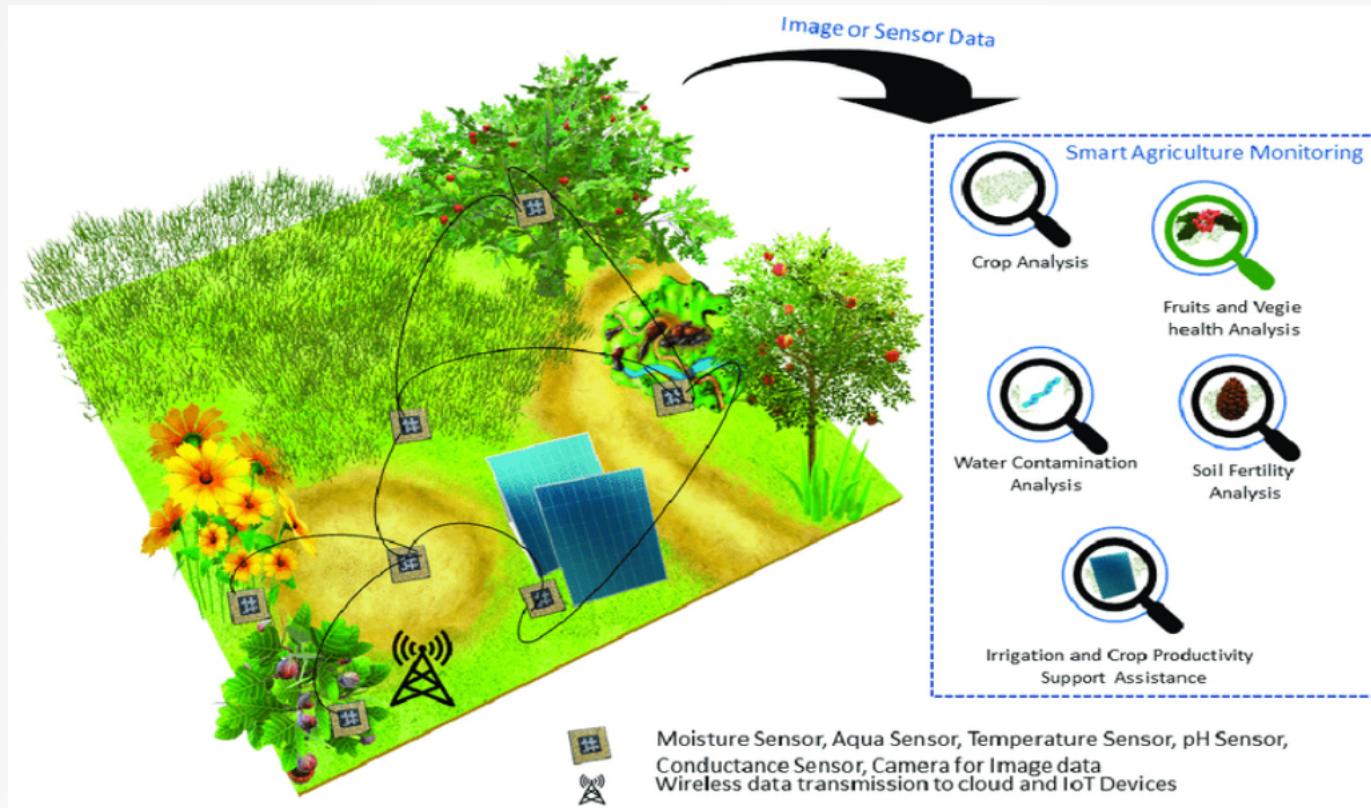
This section presents studies and research on smart agricultural monitoring (SAM) systems covering the measures for crop monitoring, pest control, fertilizer control etc. Plant growth monitoring was implemented and named as “gCrop”, using IoT, machine learning and WSN.

The work uses a regression model of the 3rd degree and provides a prediction accuracy of 98% but the computational complexity was high. The analysis of crop quality assessment was made using SAR data for monitoring the quality of paddy rice.

Leaf area and dimension also play an important role in the assessment of various types of crops, as means to determine if the growth is satisfactory or not.

An expert system using AI has been implemented in using the Naive Bayes method and machine learning which operates on sensor data captured in agriculture. This work was useful in monitoring the quality of fertilizer, pesticides and the amount of water to be irrigated in the crops.

Smart agriculture monitoring system using IoT devices and sensors.

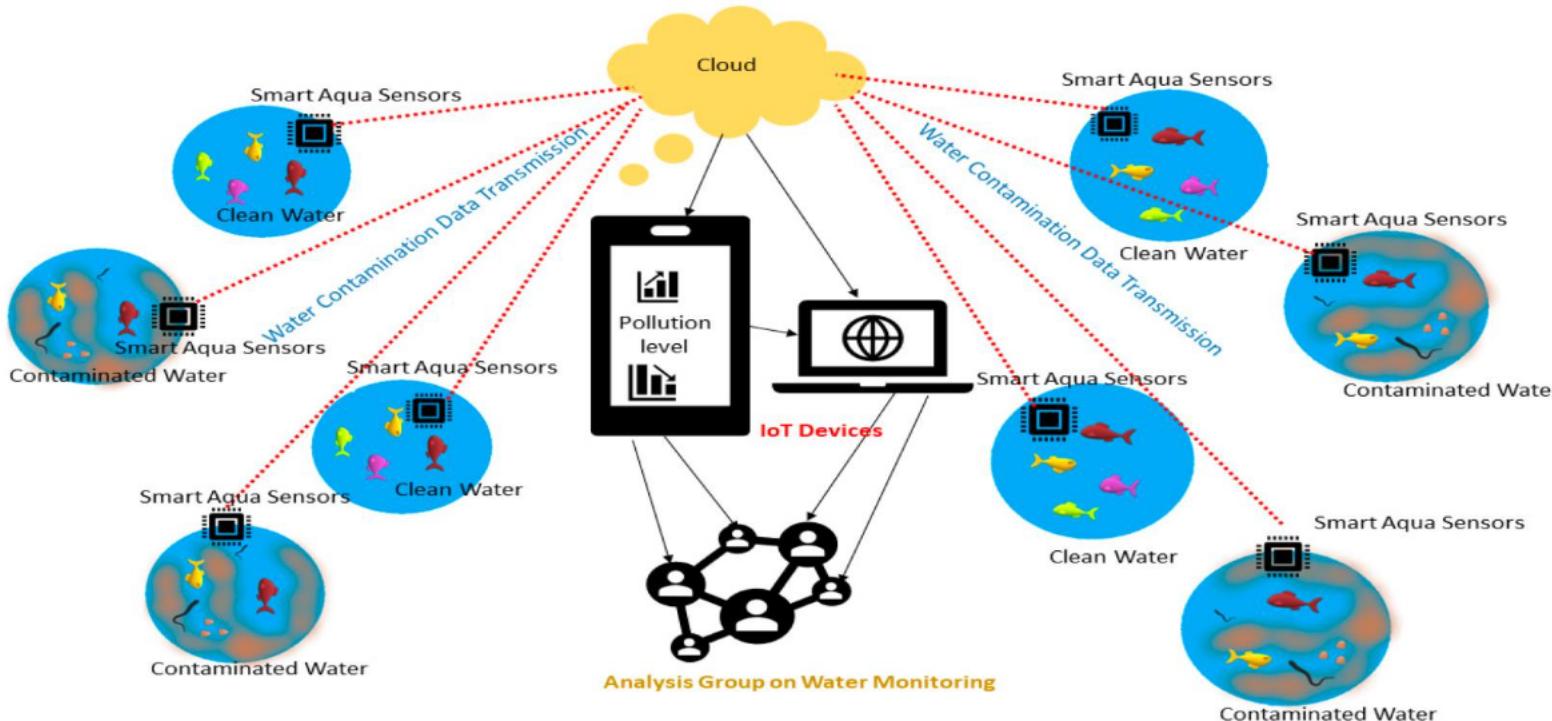


Study based on Smart Water Pollution Monitoring (SWPM) Systems

Different literature has been studied on smart water pollution monitoring (SWPM) methods and systems using machine learning methods, IoT and wireless sensors. For prediction of the pollution level in the lagoon water which are useful for agriculture remotely sensed images were analyzed and machine learning was applied.

This work used ordinary neural network based machine learning and the prediction results were not very satisfactory. Classification of water contamination has been studied and water was classified as clean or polluted water, using machine learning methods and IoT devices.

Smart environment monitoring (SEM) system highlighting water contamination monitoring using the cloud connecting internet of things (IoTs) and sensors.



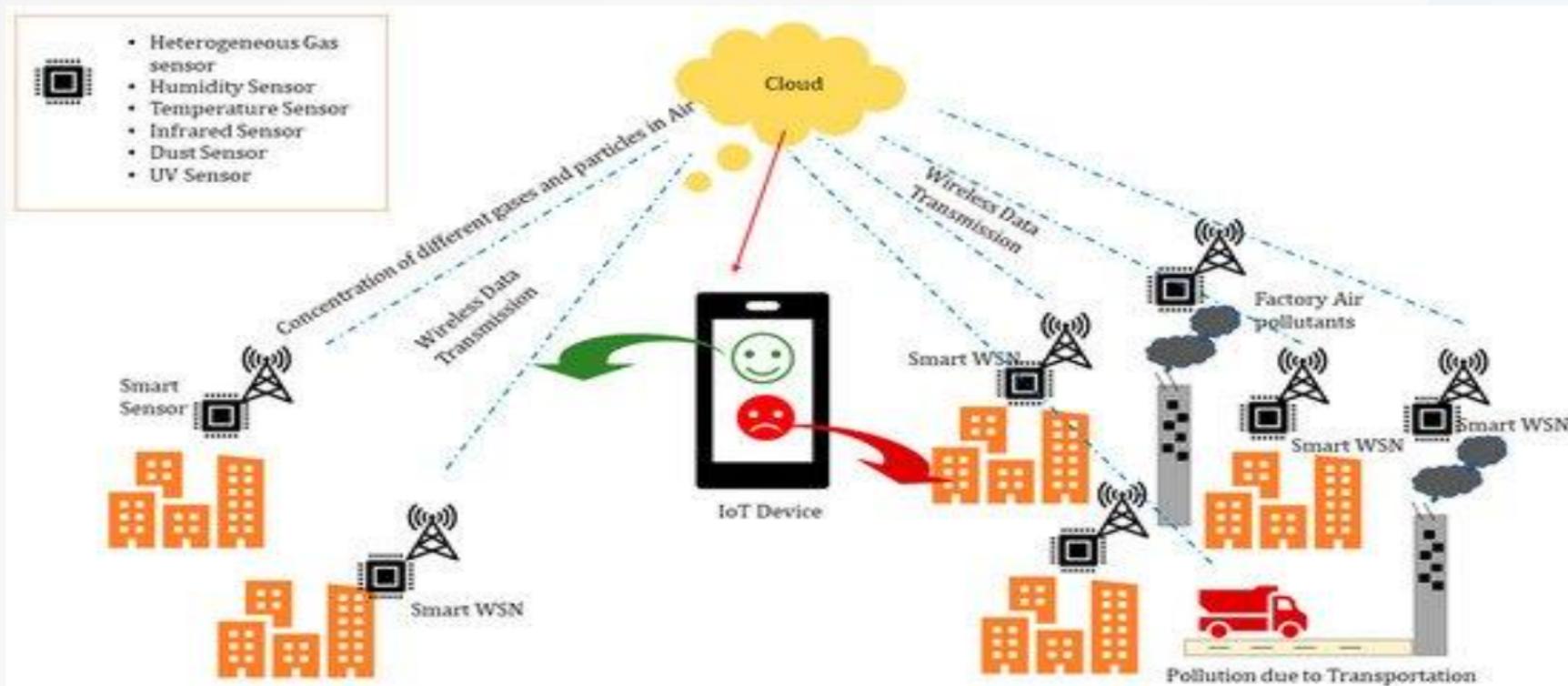
Study based on Smart Air Quality Monitoring (SAQM)

Air quality characterization has been implemented using heterogenous sensors and machine learning methods. Air quality evaluation using fixed as well as mobile nodes of sensors was implemented, capable to check the air quality in stationary as well as mobile ways.

Data captured through smart sensor nodes were processed and analyzed with the help of machine learning techniques. Another air quality control process was studied using IoT and machine learning techniques in, with a focus on assessment of air pollution, deploying gas sensors which help in capturing air particles and analyzing the pollutants mixed in the air.

Sensor networks have been established in moving vehicles for monitoring air quality with the help of machine learning in, mobile sensor nodes and WSN were deployed. Different forecasting models were suggested in for quality evaluation of urban air and the components like O₃, SO₂ and NO₂ were determined and a comparison was made for the models used in the work.

SEM system addressing various issues in the environment using wireless sensor networks (WSNs) and IoT devices.



Analysis

- The machine learning methods which have been employed for training the data and for classification are mostly traditional methods of machine learning, such as SVM, neural network, etc.
- There is no robust approach of machine learning reported, that can be employed in addressing the challenges of the environment irrespective of the purpose of the monitoring and control, types of data, and types of sensors used.
- A framework of machine learning methods needs to be developed.
- A robust set of classification, prediction and forecasting models has to be designed that can operate on any data, irrespective of the purpose of using the SEM.
- Data deduplication approaches and other methods are needed to deal with big data issues involved in a few significant studies.
- SEM aims at sustainable development of any nation and the smart agriculture and smart environment play a most important role in achieving the sustainable goals, but in rural areas, in most of the developing and underdeveloped nations, the necessary infrastructure for setting up IoT, WSN and other sensors is still a challenging task. This requires governmental level involvement both at local as well as global perspectives.

Conclusion:-

This has presented a critical review of research studies on various environment monitoring systems used for different purposes. The analysis and discussion of the review suggested major recommendations. The need of extensive research on deep learning, handling big data and noisy data issues, and a framework of robust classification approaches has been realized.

We have focused mainly on water quality, and air quality monitoring as smart agriculture systems that can deal with environmental challenges. The major challenges in implementation of smart sensors, AI and WSN need to be addressed for sustainable growth through SEM.

The poor quality of sensory data can be preprocessed using appropriate filters and signal processing methods to make the data more suitable for all subsequent tasks associated in SEM. The future scope of the work aims at studying other factors of environment such as disasters and natural calamities etc.

Additional Points

- 1) Monitoring network topology consists of Remote Segment, Core Segment and Third Party Segment (segment used for further data redistribution).
- 2) Measurements are stored inside station using erasable programmable read-only memory (eprom) which allows storing data for a minimal period of six months after which oldest data are replaced with current.
- 3) Open data structure can be used. After measurement period is reached measured data are stored compatible for read in plain text editors. Backup algorithm is implemented to allow sending data to secondary server.
- 4) Station remote configuration is done using config files together with special time.conf file used as time synchronization, received during transmission.
- 5) Critical conditions in Remote Segment are sent using sms notifications.