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IoT Based Sensor Network for Agricultural Application

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ABSTRACT

A conventional sensor network is a radio network of sensor nodes with ability to sense physical parameters, store sensed data, carry out simple processing on data and forward the data through radio interface. The objective of such network is to push the data to a sink node which can then forward the data to server (or cloud). However many real time applications includes sensors spread over long areas. As such they are treated as independent networks. Internet of Things is a new paradigm of connecting devices like microcontroller and smart objects to cloud. Using IoT services, we can now connect sensors to internet directly. In the proposed work more comprehensive state of art cloud extension of WSN through IoT has been focused, more focus on being towards bettering each of the current state of art building blocks including but not limited to sensor network, coordinator protocol, data analysis in sensor network, cloud services, IoT protocols and so on.

Keywords: *IoT; Cloud Computing; Sensor Networks*.

1.0 Introduction

One of common design of sensor network includes cluster based methods where clusters are at formed by group of nodes. These are also called coordinator nodes. These nodes gather data from all neighboring nodes. If these nodes can be linked to internet with their unique IP addresses, then the sensor network can be infinitely scaled.

The proposed research work aims at addressing the issues and challenges with the aforementioned objective of integrating sensor network over cloud using IoT services. So Internet of Things or IoT basically is connecting Embedded System to internet. Above diagram presents conceptual diagram of how basic hardware devices can be connected to could using IoT. Following diagram presents the architecture of IoT. The objective of the proposed work is to provide a proof of concept of a layered architecture of WSN over Cloud through IoT.

The architecture must define the principles of each conceptual layers and integrate the works being developed as other objectives with the framework. The research goal and objective would also include extensive analysis of the past works and a thorough comparison with proposed techniques. Qualitative and quantitative analysis of the outcome of the methods and thereby justifying the adopted approach would also remain to be primary objective.

Wireless Sensor Network (WSN) has been one of the most prominent research areas over last decade. It attributed in many different areas of applications including agriculture, defense, Environmental studies and so on. But one of the inherent flaws with the design of Sensor networks is that the range of the network is limited due to limited radio range that they operate into. Further as WSN mainly uses 802.15.4 as link layer protocol to save power, the effective bandwidth is limited to only 256 kbps.

This restricts the sensor network as low computation data processing and data collection network.

Internet of things (IoT) has opened up a whole new possibilities in microcomputer and hardware by introducing the ability to connect smaller hardware to internet and by allocating individual IP addresses to these devices by leveraging IPv6 addressing scheme. IoT enables the devices to connect to internet with higher bandwidth. These devices can now access host

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of services offered through cloud including data mining services, storage and visualization services, security services and so on. Therefore IoT brings to table the ability to connect WSN over cloud. The coordinator nodes can be connected to internet through IoT.

These coordinators can gather and process data locally from nearby sensor over existing WSN protocols.

This data can then be stored and processed over cloud through IoT framework. However review of literature reveals very little work in the direction of perceiving WSN over cloud through IoT.

There is a distinct need of extensive research and new paradigms that enables defines new services and protocols in this area. In our research we would like to explore this void research area and come up with practical solutions in service, architecture and protocol level for integrating WSN with IoT without significant change in basic WSN or IoT framework.

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The objective of such network is to push the data to a sink node which can then forward the data to server (or cloud).

However many real time applications includes sensors spread over long areas. As such they are treated as independent networks.

Internet of Things is a new paradigm of connecting devices like microcontrollers and smart objects to cloud. Using IoT services, we can now connect sensors to internet directly.

One of common design of sensor network includes cluster based methods where clusters are at formed by group of nodes.

These are also called coordinator nodes. These nodes gather data from all neighboring nodes. If these nodes can be linked to internet with their unique Ip addresses, then the sensor network can be infinitely scaled (theoretically).

The proposed research work aims at addressing the issues and challenges with the aforementioned objective of integrating sensor network over cloud using IoT services.

Fig 1: Conventional Sensor Network

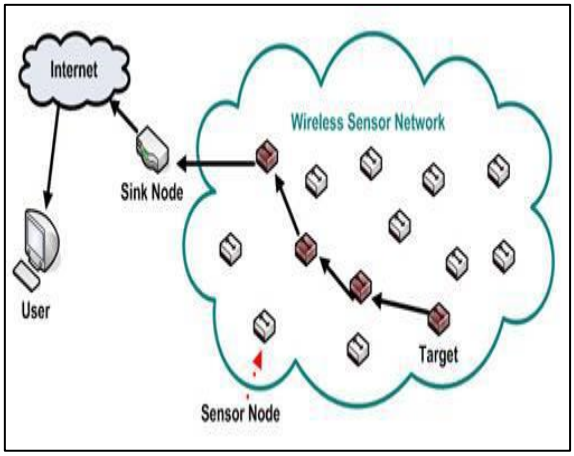
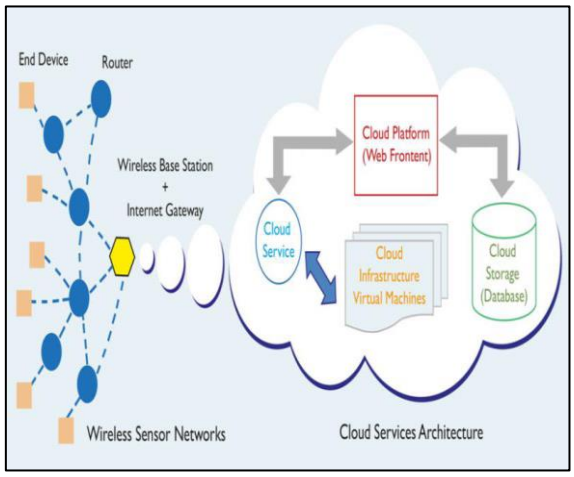


Fig 2: Sensor Network Over Cloud



So Internet of Things or IoT basically is connecting Embedded System to internet. Above diagram presents conceptual diagram of how basic hardware devices can be connected to could use IoT. Following diagram presents the architecture of IoT. Wireless Sensor Network (WSN) has been one of the most prominent research areas over last decade. It attributed in many different areas of applications including agriculture, defense, Environmental studies and so on. But one of the inherent flaw with the design of Sensor networks is that the range of the network is limited due to limited radio range that they operate into. Further as WSN mainly uses 802.15.4 as link layer protocol to save power, the effective bandwidth is limited to only 256 kbps.

This restricts the sensor network as low computation data processing and data collection network. Internet of things (IoT) has opened up a whole new possibilities in microcomputer and hardware by introducing the ability to connect smaller hardware to internet and by allocating individual IP addresses to these devices by leveraging IPv6 addressing scheme. IoT enables the devices to connect to internet with higher bandwidth. These devices can now access host of services offered through cloud including data mining services, storage and visualization services, security services and so on. Therefore IoT brings to table the ability to connect WSN over cloud. The coordinator nodes can be connected to internet through IoT. These coordinators can gather and process data locally from nearby sensor over existing WSN protocols. This data can then be stored and processed over cloud through IoT framework. This leads to exciting new opportunities. For example now a fire sensing system can trigger fire fighting water outlet driven by relayes and controlled via PLC to trigger water outflow on areas where fire is caught up. However review of literature reveals very little work in the direction of perceiving WSN over cloud through IoT. There is a distinct need of extensive research and new paradigms that enables defines new services and protocols in this area. In this research we would like to explore this void research area and comup with practical solutions in service, architecture and protocol level for integrating WSN with IoT without significant change in basic WSN or IoT framework.

1.1 Possible outcome or solution to the problem

In the proposed work we mainly focus on building more comprehensive state of art cloud extension of WSN through IoT. Firstly the research would focus towards bettering each of the current state of art building blocks including but not limited to sensor network, coordinator protocol, data analysis in sensor network, cloud services, IoT protocols and so on. The methodology must provide techniques that address current issues and challenges in the proposed research domain.

One of the first expected results would be a unique framework to connect existing WSN to cloud. Then system should prove the advantage of such extension by demonstrating the scale of improvement in data analysis services. Results should prove that IoT can be used to create mesh sensor networks and enhanced bandwidth can be used to connect sensor network with other control system. Results must clearly demonstrate the pros and cons of the layers and designed protocols though quantitative analysis and must be presentable as proof of concept for system robustness.

2.0 Literature Survey

Charith perera and Arkady [1] proposed a project using IOT techniques to demonstrate an adjustable living environment control system. D.L.Yang and F. Liu [2] made a survey of the IOT based RFID systems, sensor networks and intelligence in smart objects and also it enables communication between people and things and between things themselves. Caragliu et al, [3] proposed a project on smart cities in Europe using IoT techniques and demonstrated an advance triple-helix network model for smart performance. Global K.Ashton [4] described that ‘internet of things’ as thing in real world, things matter more than ideas by linking the new idea of RFID in P&G’s supply chain to the then red-hot topic of the internet.

A.Zaslavsky et al.,[5] explained sensing as a service and big data using Data streams coming from these devices will challenge the traditional approaches to data management and contribute to the emerging paradigm of bigdata. H. Sundmaeker and P.Guillemin [6] explored the Vision and challenges for realizing the internet of things based key enabling technology like cloud implementation using aneka which is based on interaction of private and public cloud presented. P.Guillemin and P.Friess [7] described internet of things strategic research roadmap using IoT technology which allows identifying research and developing challenges and outlining a roadmap for a future reliable technique.

H Chourabi and T Nam [8] proposed the concept of Understanding smart cities, an integrative frame work using management & organization, technology, governance policy, context ,people and communities ,economy, built infrastructure and natural environment. Hemant Ghayvat et al.,[9] proposed a WSN and IOT based Smart Homes And Their Extension To Smart Buildings to develop smart living environment. Younis, M et al. [10] conducted a survey on Topology management techniques for tolerating node failures in wireless sensor networks.”Which focused on network topology

management techniques for tolerating/handling node failures in WSNs. Challoo, R et al.,[11] gave an Overview and Assessment of Wireless Technologies and Co-existence of ZigBee, Bluetooth and Wi-Fi Devices. "to show that there is a severe degradation on ZigBee and Bluetooth packet transmission of packets as well as re-transmission of ZigBee packets when Wi-Fi is operating. Hwang, K et al.,[12]proposed a Enhanced self-configuration scheme for a robust ZigBee-based home automation which is an enhanced self-configuration (ESC) scheme that improves the robustness of the conventional ZigBee-based home automation systems by coping well with orphan propagation problem and dynamic error environments. Byun,J et al.,[13] proposed an intelligent self-adjusting sensor for smart home services based on ZigBee Communications.which is a situation-based self adjusting scheme, and also an event-based self-adjusting sensor network and hardware and middleware implementation. Bell, C et al., [14] proposed a concept of examining social media use among older adults. for understanding the factors that influence social media use in older adults. Dawadi, P.N et al., [15] made an automated assessment of cognitive health using smart home technologies. Whose goal was to develop intelligent systems to monitor the wellbeing of individuals in their home environments?

3.0 Proposed System

A conventional sensor network is a radio network of sensor nodes with ability to sense physical parameters, store sensed data, carry out simple processing on data and forward the data through radio interface. The objective of such network is to push the data to a sink node which can then forward the data to server (or cloud).

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to explore this void research area and come with practical solutions in service, architecture and protocol level for integrating WSN with IoT without significant change in basic WSN or IoT framework.

4.0 Procedure

The following are the innovative research extensions to the existing WSN and IoT framework.

1) Firstly focus purely on sensors and that too on coordinator nodes in Peripheral hardware. Rather than working on integrating individual hardware over cloud, our method would assume entire standalone sensor network as a single peripheral and would connect that to cloud though IoT.
2) Focus mainly on ZigBee as wireless technology as that is most accepted WSN standard.
3) This method would provide not only communication services but also data gathering and analysis services.
4) Then integrating, both simulation as well as real time test beds to prove the designed concepts. The research goal and objective would also include extensive analysis of the past works and a thorough comparison with proposed techniques. Qualitative and quantitative analysis of the outcome of the methods and thereby justifying the adopted approach would also remain to be primary objective.

Fig 3: Objective of the Research

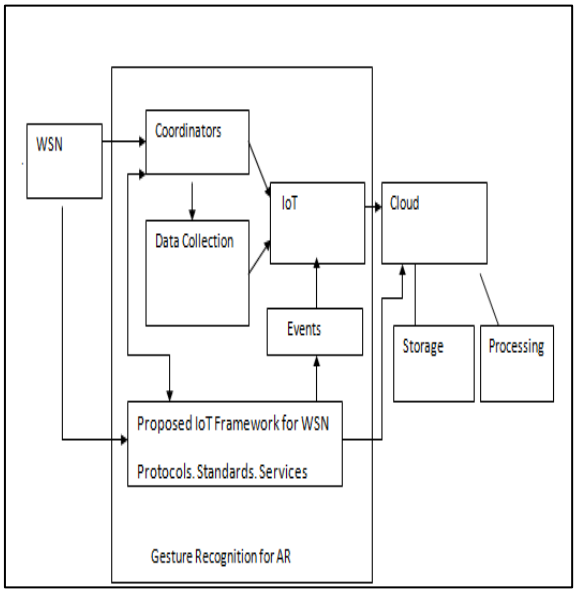


Fig 4: Cloud of Sensors

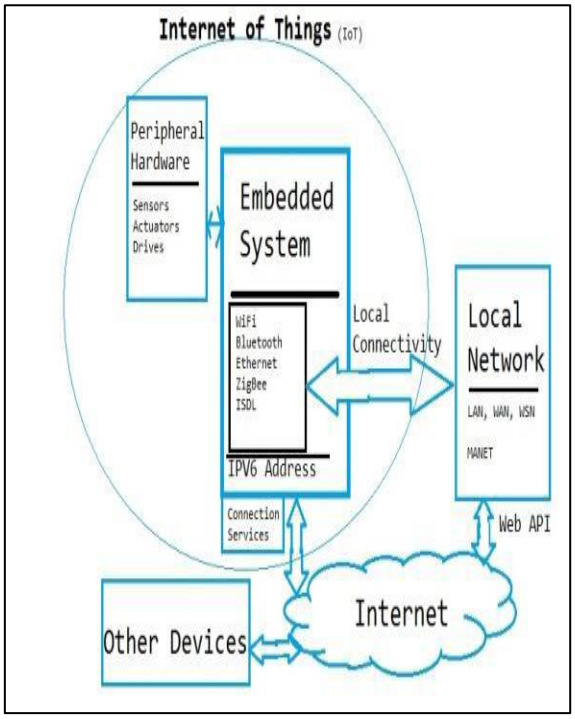
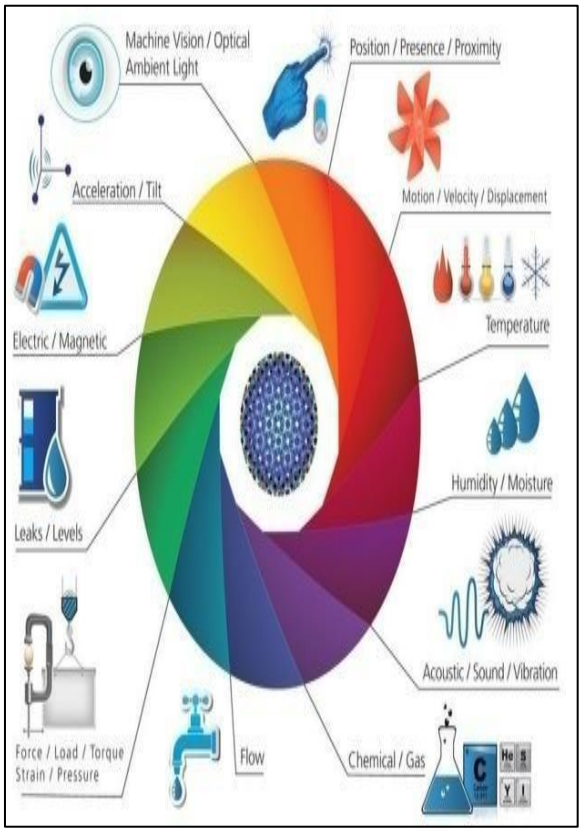


Fig 5: Structure of IOT



The basic architecture of IoT is presented above. Our work would include following innovative research extensions to the existing WSN and IoT framework.

1) Firstly we would focus purely on sensors and that too on coordinator nodes in Peripheral hardware. Rather than working on integrating individual hardware over cloud, our method would assume entire standalone sensor network as a single peripheral and would connect that to cloud though IoT.
2) We would focus mainly on ZigBee as wireless technology as that is most accepted WSN standard.
3) Our methods would provide not only communication services but also data gathering and analysis services.
4) We would integrate both simulation as well as real time test beds to prove the designed concepts.

In the proposed work we mainly focus on building more comprehensive state of art cloud extension of WSN through IoT.

Firstly the research would focus towards bettering each of the current state of art building blocks including but not limited to sensor network, coordinator protocol, data analysis in sensor network, cloud services, IoT protocols and so on. The methodology must provide techniques that address current issues and challenges in the proposed research domain.

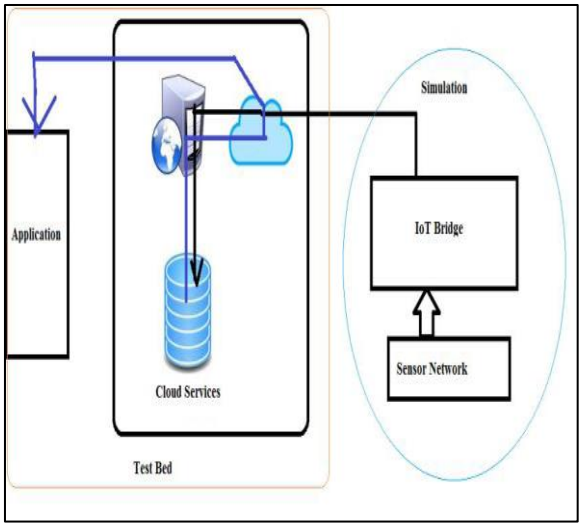
One of the first expected results would be a unique framework to connect existing WSN to cloud. Then system should prove the advantage of such extension by demonstrating the scale of improvement in data analysis services.

Results should prove that IoT can be used to create mesh sensor networks and enhanced bandwidth can be used to connect sensor networks with other control system.

Results must clearly demonstrate the pros and cons of the layers and designed protocols though quantitative analysis and must be presentable as proof of concept for system robustness.

Possible outcome can be presented through following diagram:

Fig.6: Objective of the Research



5.0 Conclusions

One of the first expected results would be a unique framework to connect existing WSN to cloud. Then system should prove the advantage of such extension by demonstrating the scale of improvement in data analysis services.

Results should prove that IoT can be used to create mesh sensor networks and enhanced bandwidth can be used to connect sensor network with other control system.

Results must clearly demonstrate the pros and cons of the layers and designed protocols though quantitative analysis and must be presentable as proof of concept for system robustness.

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