Smart Farming with Wireless Sensor Network using Threshold Function

Prakash Kumar[1], Rajeev Raghuwanshi[2]
[1]Research Scholar, [2]Assistant Professor and Head
[1,2]Dept of CSE, MITS, Bhopal, India

Abstract- *IoT frameworks permit clients to accomplish further computerization, examination, and incorporation inside a framework. They improve the compass of these zones and their exactness. IoT abuses late advances in programming, falling equipment costs, and present day mentalities towards innovation. Its new and progressed components acquire significant changes the conveyance of items, merchandise, and benefits; and the social, financial, and political effect of those changes. As homesteads and horticulture essentially accessible in provincial zones, associating the short-run WSN from significant distance and explaining the ranch related issues actually testing. Because of high blockage zone, parcel got proportion turns out to be low, since the versatile idea of sensor hub is corrupt. The proposed WSN based IoT work with Sensor hub separation limit work, give compelling utilization of sensor hub in cultivating innovation. The philosophy actualized on NS2 tool kit, which is designed in WSN based Routing convention. The result shows that it gives improved sensor hub working in IoT based savvy cultivating. The PRR is improve by 11.3% when growing number of center points. Defer time is decrease upto 17.1% when growing number of center points.*
Keywords: IoT, NS2, Smart Farming, Delay Time, PRR, WSN.

1. INTRODUCTION

Web of Things (IoT) comprises of two words- Internet and Things. The expressions "Things" in IoT alludes to different IoT gadgets having one of a kind personalities and have capacities to perform distant detecting, impelling and live observing of specific kinds of information. IoT gadgets are additionally empowered to have live trade of information with other associated gadgets and applications either straightforwardly or by implication, or gather information from different gadgets and cycle the information and send the information to different workers. The other term "Web" is characterized as Global Communication organize associating trillions of PCs over the planet empowering sharing of data. As determined by different specialists, 50 Billion gadgets dependent on IoT would be associated all over the planet by year 2020. The Internet of Things (IoT) has been characterized as: A Dynamic worldwide system foundation with self-arranging abilities dependent on standard and interoperable correspondence conventions where physical and virtual "Things" have characters, physical traits, and virtual characters and utilize wise interfaces and are flawlessly incorporated into the data organize, frequently convey information related with clients and their surroundings". An ideal IoT gadget comprises of different interfaces for making network to different gadgets which can either be wired or remote. Any IoT based gadget comprises of following parts:

- I/O interface for Sensors.
- Interface for associating with Internet.
- Interface for Memory and Storage.
- Interface for Audio/Video.
- IoT gadgets can be of different structures like wearable sensors, savvy watches, IoT brilliant home observing, IoT insightful vehicle frameworks, IoT shrewd wellbeing gadgets and so on.

Web of Things has a solid spine of different empowering advances Wireless Sensor Networks, Cloud Computing, Big Data, Embedded Systems, Security Protocols and Architectures, Protocols empowering correspondence, web administrations, Internet and Search Engines.

Remote Sensor Network (WSN): It comprises of different sensors/hubs which are coordinated together to screen different kinds of information.

Distributed computing: Cloud Computing otherwise called on-request figuring is a kind of Internet-based registering which gives shared handling assets and information to PCs and different gadgets on request.

It tends to be indifferent structures like IaaS, PaaS, SaaS, DaaS, and so on.

Enormous Data Analytics: Big information investigation is the way toward looking at huge informational indexes containing different types of information types—for example Enormous Data – to reveal shrouded designs, obscure relationships, market patterns, client inclinations, and other valuable business data.

Correspondence Protocols: They structure the foundation of IoT frameworks to empower availability and coupling to applications and these conventions encourage trade of information over the system as these conventions empower information trade designs, information encoding, and tending to.

Implanted Systems: It is such a PC framework that comprises of both equipment and programming to perform explicit errands. It incorporates chip/microcontroller, RAM/ROM, organizing parts, I/O units, and capacity gadgets.

With the appropriation of IoT in different territories like Industry, Homes, and even Cities, colossal potential apparently makes everything Intelligent and Smart. Indeed, even the Agricultural segment is additionally embracing IoT innovation nowadays and this thus has prompted the improvement of "Horticultural Internet of Things (IoT)".

2. BACKGROUND

[1] Web of Things (IoT) gives another measurement in the region of brilliant cultivating and agribusiness area. With the utilization of haze registering and WiFi-based significant distance network in IoT, it is conceivable to interface the agribusiness and cultivating bases arranged in rustic zones productively. To zero in on the particular necessities, we propose a versatile organization design for checking and controlling horticulture and homesteads in rustic zones.

[2] Web of Thing (IoT) innovation has empowered productive harvest observing to help dynamic in accuracy farming. The checking framework gathers natural information in fields. A significant test in the observing framework is restricted vitality intensity of IoT sensor hubs. Subsequently, we propose a vitality proficient transmission structure for IoT sensors in the checking framework. Our proposed system permits the sensor hubs to adaptively gather information upon the ecological change.

[3] We tackle the channel dispute and concealed terminal issues of offbeat obligation cycle MAC conventions under weighty traffic situations. To determine the issues, we plan a line-based burst transmission MAC convention (Q-BT), in which couples burst (and quick) transmission and no concurrent obligation cycle are included together by utilizing line length data.

[4] Horticulture division being the foundation of the Indian economy merits security. Security is not as far as assets just yet in addition agrarian items need security and assurance at the beginning stage, similar to insurance from assaults of rodents or bugs, in fields or grain stores. Such difficulties ought to likewise be contemplated. Security frameworks which are being utilized now daily are not brilliant enough to give constant warning subsequent to detecting the issue.

[5] The Internet of Things (IoT) is creating an uncommon volume and assortment of information. Be that as it may, when the information advances toward the cloud for investigation, the chance to follow up on it may be gone. This white paper, expected for IT and operational innovation experts, clarifies another model for dissecting and following up on IoT information.

3. PROBLEM IDENTIFICATION AND OBJECTIVES

As homesteads and agribusiness are principally accessible in rustic zones, associating the short-extend WSN from a significant distance and settling trench-related issues despite everything testing. Further, provisioning QoS for such applications to satisfy diverse organization necessities is significant. The recognized issue in existing work is according to the accompanying:

- Due to the high congestion area, a packet received ratio becomes low since the adaptive nature of the sensor node is degraded.
- Due to transmission and processing delay at multiple nodes, end to end delay time may increase.

The basic objections of my hypothesis work are according to the accompanying:

- To improve bundle got proportion in blockage zone then the idea of sensor hub gets versatile.

• To diminish start to finish defer the time at each hub then IoT network turns out to be successfully improving.

4. METHODOLOGY

The proposed system is an association of different organizations having multi-bounce correspondence in every one of the modules. Thus, a key worry of the proposed thick organization geography is the start to finish delay. The essential options of deferrals are as per the following:

1) Transmission and handling delay, and if there are numerous bounces, this postpone will be duplicated,

2) Propagation delay, which is subject to the Euclidian separation between two closures and speed of remote signs.

Let us consider the sensor network component for delay calculation. If d be the distance covered by a wireless signal travel per unit time and $E_{i,j}$ be the Euclidian distance between any pair of nodes i and j, then the discrete propagation delay in a one-hop link (i, j) will be [$E_{i,j}/d$]. So, delay over multihop is the sum of one-hop delay. If first-hop delay is $D1$ and total delay is D_{total} then for WSN

$$\mathcal{D}_1 = \left[\frac{E_{i,j}}{d} + \Delta\right]$$

$$\mathcal{D}_w = \sum_{hop=i}^{j-1} \left[\frac{E_{i,j}}{d} |+ \Delta\right].$$

Similarly, for the WiLD network, from node j to gateway k, multihop delay (DW) can be given by

$$\mathcal{D}_W = \sum_{hop=j}^{k-1} \left[\frac{E_{j,k}}{d} + \Delta\right].$$

T = Dist(D_w>t)

T is equivalent with threshold value of sensor node energy then the total delay would be

$$D\text{total} = (Dw + DW) - T$$

As the WSN gateway and WiFi nodes are fog nodes, the decision can be processed and action can be taken from these nodes. Any decision taken in j node (i.e., first fog node), total delay ($T1$) for complete sensing and actuation operation would be

$$T1 = 2Dw + Dp - T$$

where Dp is the decision processing delay in a fog node, which depends on the availability of sensor data and processing capabilities of the system. Again, for the first WiLD node, i.e., second fog node, $j + 1$

$$T2 = 2(Dw + D2) + Dp$$

Similarly, for remaining fog nodes $j + 2$, $j + 3$,..., and k, the total action time can be calculated and finally the time required, if the gateway node is used as fog is calculated as

$$T_{k-1} = 2\left(\mathcal{D}_w + \mathcal{D}_{k-1} + \mathcal{D}_{k-2} + \cdots + \mathcal{D}_j\right) + \mathcal{D}_p$$

$$T_{k-1} = T_{k-1} - T$$

Where $D_{k-1} + D_{k-2} + \ldots + Dj = D_W$. From above equation, it is clear that $T1 < T2 < \ldots < Tk-1$. Based on the critical nature of different agricultural applications and to share the processing of data, priority of choosing a fog node ranges from j to k. Similarly, fog computing in the system can save bandwidth of the network up to a huge amount. For sending a packet P in the WiLD network having capacity C, required bandwidth is Breq = (P/δ), where δ is the transmission time and Breq $\leq C$. However, a fog node holding the responsibility to process the packet does not further forward the data to next hop saving bandwidth Breq for the remaining of the network.

The method is Sensor Node with Distance Threshold Function (SN-DTF), which is described through following point.

1. Let us consider the sensor network component for delay calculation. If d be the distance covered by a wireless signal travel per unit time and $E_{i,j}$ be the Euclidian distance between any pair of nodes i and j, then the discrete propagation delay in a one-hop link (i, j) will be [$E_{i,j}/d$]. So, delay over multihop is the sum of one-hop delay. If first hop delay is $D1$ and total delay is D_{total} then for WSN

2. Similarly, for the WiLD network, from node j to gateway k, multihop delay (DW) can be given by

T = Dist(D_w>t)

T is equivalent with threshold value of sensor node energy then the total delay would be

$$D\text{total} = (Dw + DW) - T$$

3. As the WSN gateway and WiFi nodes are fog nodes, the decision can be processed and action can be taken from these nodes.

4. Any decision taken in j node (i.e., first fog node), total delay ($T1$) for complete sensing and actuation operation would be

$$T1 = 2Dw + Dp - T$$

where Dp is the decision processing delay in a fog node, which depends on the availability of sensor data and processing capabilities of the system.

5. Again, for the first WiLD node, i.e., second fog node, $j + 1$

$T2 = 2(Dw + D2) + Dp$

Similarly, for remaining fog nodes $j + 2, j + 3, \ldots,$ and k, the total action time can be calculated and finally the time required, if the gateway node is used as fog is calculated as

$T_{k-1} = T_{k-1} - T$

Where $D_{k-1} + D_{k-2} + \ldots + Dj = D_W$. From above equation, it is clear that $T1 < T2 < \ldots < Tk-1$.

5. RESULTS AND ANALYSIS

When the bundle from WSN is gotten by the nearby door, the passage advances it to the WiLD organization. To guarantee QoS prerequisites over such significant distance organizations, mist registering is utilized. To re-enact the proposed calculation system, we have utilized iFogSim test system. Detail re-enactment boundaries are referenced in past area. The re-enactment is done over tree-based WiLD organization geography. To cover a bigger region and to test the haze execution over a different size of the organization, WiLD hubs (mist hubs) are expanded from 1 to 19 in the middle of the cloud and the sensor gadget. WiLD hubs are situated in a various leveled way and the end hubs are liable for associating the sensor/actuator hubs. In view of the quantity of mist hubs across physical geography setups situations 1–5 of hubs 1, 5, 10, 15, and 19, separately, are thought of. Two situation procedures, viz., cloud and haze are made.

Table 1: Packet Received Ratio(%) as per increasing number of nodes

Nodes	XMAC[1]	SN_DTF(Proposed)
10	61.3	68.23
20	58.72	62.91
30	38.37	45.17
40	12.47	23.18
50	10.71	18.82

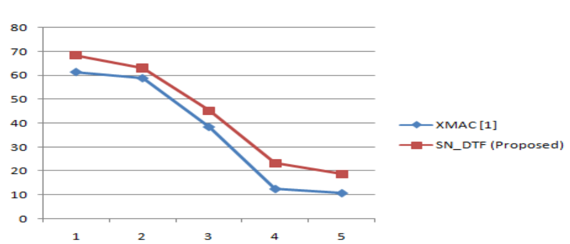

Figure 1: Comparison of PRR(%) at y axis as per number of nodes (x axis)

The proposed method SN_DTF perform outstanding result in case packet received ratio. When specify 10 nodes PRR of SN_DTF is 68.23% instead of 61.3%. Similarly for 50 nodes, PRR of SN_DTF is 18.82% instead of 10.71%.

Table 2: Delay Time(ms) as per increasing number of nodes

Nodes	XMAC[1]	SN_DTF (Proposed)
10	27.31	22.38
20	55.72	48.52
30	98.21	91.32
40	162.73	151.55
50	186.37	178.62

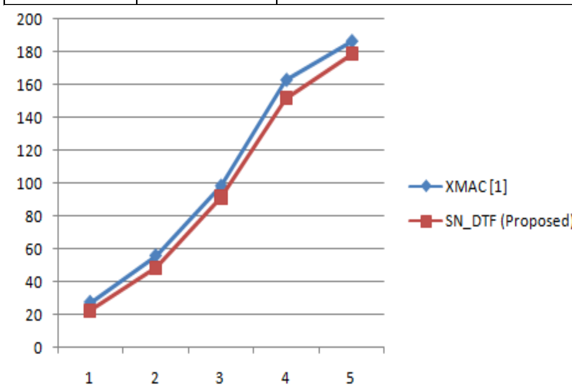

Figure 2: Comparison of Delay Time(ms) at y axis as per number of nodes (x axis)

The proposed method SN_DTF perform outstanding result in case of delay time. When specify 10 nodes delay time of SN_DTF is 22.38(ms) instead of 27.31(ms). Similarly for 50 nodes, delay time of SN_DTF is 178.62(ms) instead of 186.37(ms).

Table 3: Packet Received Ratio(%) as per increasing load(kbps) on sensors

Load (Kbps)	XMAC[1]	SN_DTF (Proposed)
50	98.12	98.78
100	91.53	94.22
150	74.26	78.31
200	61.42	66.52
250	48.23	52.81

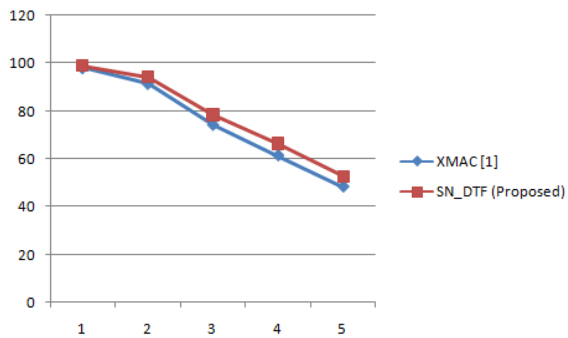

Figure 3: Comparison of PRR(%) at y axis as per load (Kbps) at sensor node (x axis)

The proposed method SN_DTF perform outstanding result in case of PRR. When specify 10 nodes PRR of SN_DTF is 98.78% instead of 98.12%. Similarly for 50 nodes, PRR of SN_DTF is 52.81% instead of 48.23%.

Table 4: Delay Time(ms) as per increasing load (Kbps) of sensor nodes

Load (Kbps)	XMAC[1]	SN_DTF (Proposed)
50	48.11	43.62
100	50.25	47.41
150	101.38	93.56
200	175.29	168.32
250	257.31	248.41

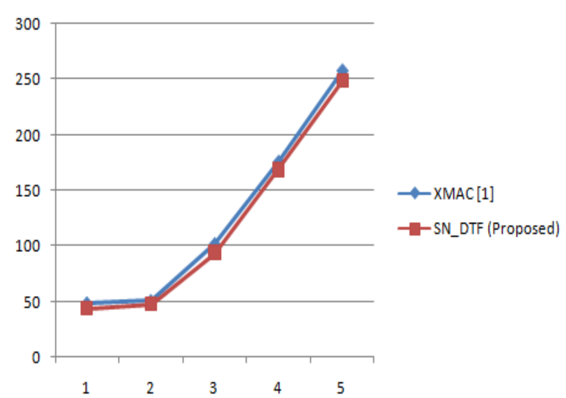

Figure 4: Comparison of Delay Time(ms) at y axis as per load (Kbps) at sensor node (x axis)

The proposed method SN_DTF perform outstanding result in case of delay time. When specify 10 nodes delay time of SN_DTF is 43.62(ms) instead of 48.11(ms). Similarly for 50 nodes, PRR of SN_DTF is 248.11(ms) instead of 257.31(ms).

6. CONCLUSIONS

A vitality productive transmission structure for an IoT observing framework in an exactness cultivating. The proposed system comprises of five modes which are tuning in, gathering information, communicating information, rest, and inert mode. For every mode, we center on vitality proficiency so the vitality power for the general checking measure is productively utilized. We have likewise proposed an information driven transmission calculation dependent on a covetous technique to utilize in the sending information method of our proposed structure.

The MAC and steering answer for IoT have accomplished better vitality, postponement, and throughput execution. Consolidating the proposed arrangement with the WSN organization, it is conceivable to lessen defer and improve throughput for end mile network.

The economy of a creating nation mostly relies upon agribusiness and ranches in country territories and applying customary methodologies isn't adequate. Utilization of current innovations like IoT with minimal effort and adaptable arrangements are significant.

The PRR is improve by 11.3% when expanding number of hubs. Defer time is lessen upto 17.1% when expanding number of hubs.

There are numerous likely uses of WSNs in the agribusiness and cultivating territory. The present status of-the-craftsmanship remembers most works for water system the executives, grape plantation creation checking, and crop ailment forecast.

REFERENCES

[1] Nurzaman Ahmed, Debashis De and Md. Iftekhar Hussain, "Internet of Things (IoT) for Smart Precision Agriculture and Farming in Rural Areas", IEEE Internet of Things Journal, Vol. 5, No. 6, December 2020.

[2] Peerapak Lerdsuwan and Phond Phunchongharn, "An Energy-Efficient Transmission Framework for IoT Monitoring Systems in Precision Agriculture", Springer Journal of Nature, 2019.

[3] Seungbeom Jeong, Hyung-Sin Kim, Sung-Guk Yoon and Saewoong Bahk, "Q-BT: Queue-based Burst Transmission over an Asynchronous Duty-cycle MAC Protocol", IEEE Communications Letters, 2018.

[4] Tanmay Baranwal, Nitika and Pushpendra Kumar Pateriya, “Development of IoT based Smart Security and Monitoring Devices for Agriculture”, IEEE Journal of Sensors, 2016.
[5] Hyung-Sin Kim, “Fog Computing and the Internet of Things: Extend the Cloud to Where the Things Are”, International Journal of Cisco, 2016.
[6] Eva Marín Tordera, Xavi Masip-Bruin, Jordi García-Almiñana, Admela Jukan, Guang-Jie Ren, Jiafeng Zhu and Josep Farré, “What is a Fog Node? A Tutorial on Current Concepts towards a Common Definition”, ACM Transaction of Fog Computing, 2016.
[7] LIU Dan, Cao Xin, Huang Chongwei and JI Liangliang, “Intellegence Agriculture Greenhouse Environment Monitoring System based on IoT Technology”, International Conference on Intelligent Transportation, Big Data & Smart City, 2015.
[8] Carlos Cambra, Juan R. Díaz and Jaime Lloret,“Deployment and Performance Study of an Ad Hoc Network Protocol for Intelligent Video Sensing in Precision Agriculture”, Springer-Verlag Berlin Heidelberg 2015.
[9] Tamoghna Ojha, Sudip Misra, Narendra Singh Raghuwanshi, “Wireless sensor networks for agriculture: The state-of-the-art in practice and future challenges”, Elsevier Journal of Computers and Electronics in Agriculture, 2015.
[10] Joaquín Gutiérrez, Juan Francisco Villa-Medina, Alejandra Nieto-Garibay, Miguel Ángel and Porta-Gándara, “Automated Irrigation System Using a Wireless Sensor Network and GPRS Module”, IEEE Transactions on Instrumentation and Measurement, Vol. 63, No. 1, January 2014.
[11] Mohamed Rawidean Mohd Kassim, Ibrahim Mat, Ahmad Nizar Harun, “Wireless Sensor Network in Precision Agriculture Application”, IEEE Journal of Sensor, 2014.
[12] Gayatri Sakya and Vidushi Sharma, “Performance Analysis of SMAC Protocol in Wireless Sensor Networks Using Network Simulator (Ns-2)”, Institute for Computer Sciences, Social Informatics and Telecommunications Engineering, 2013.
[13] Adam Dunkels, “The ContikiMAC Radio Duty Cycling Protocol”, Springer Journal of WSN, 2011.
[14] Luca Mainetti, Luigi Patrono and Antonio Vilei, “Evolution of Wireless Sensor Networks towards the Internet of Things: a Survey”, Springer Journal of WSN, 2011.
[15] Yingli Zhu, Jingjiang Song, Fuzhou Dong, “Applications of wireless sensor network in the agriculture environment monitoring”, International Workshop on Automobile, Power and Energy Engineering, 2011.
[16] Christophe J. Merlin and Wendi B. Heinzelman, “Duty Cycle Control for Low-Power-Listening MAC Protocols”, IEEE Transactions on Mobile Computing, Vol. 9, No. 11, November 2010.
[17] Christophe J. Merlin and Wendi B. Heinzelman, “Schedule Adaptation of Low-Power-Listening Protocols for Wireless Sensor Networks”, IEEE Transactions on Mobile Computing, Vol. 9, No. 5, May 2010.
[18] Mahta Moghaddam, Dara Entekhabi, Yuriy Goykhman, Ke Li, Mingyan Liu, Aditya Mahajan, Ashutosh Nayyar, David Shuman and Demosthenis Teneketzis, “A Wireless Soil Moisture Smart Sensor Web Using Physics-Based Optimal Control: Concept and Initial Demonstrations”, IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, Vol. 3, No. 4, December 2010.
[19] Michael Armbrust, Armando Fox, Rean Griffith, Anthony D. Joseph, Randy Katz, Andy Konwinski, Gunho Lee, Dav id Patterson, Ariel Rabkin, Ion Stoica, and Matei Zaharia “A View of Cloud Computing”, communications of the ac m, vol. 53 , no. 4, 2010.
[20] Jonathan Hui, David Culler, Samita Chakrabarti, “6LoWPAN: Incorporating IEEE 802.15.4 into the IP architecture”, Internet Protocol for Smart Objects (IPSO) Alliance, 2009.
[21] Bhaskaran Raman and Kameswari Chebrolu, Kanpur “Experiences in Using WiFi for Rural Internet in India”, IEEE Communications Magazine, January 2007.
[22] Kameswari Chebrolu and Bhaskaran Raman, “FRACTEL: A Fresh Perspective on (Rural) Mesh Networks”, NSDR’07, August 27, 2007.
[23] Michael Buettner, Gary V. Yee, Eric Anderson, Richard Han, “X-MAC: A Short Preamble MAC Protocol for Duty-Cycled Wireless Sensor Networks”, ACM Journal of Sensors, 2006.