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A novel approach on improving the communication performance in wireless sensor networks using path selection algorithms

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ABSTRACT

In recent years, Internet of Things (IoT) has gained more importance in various fields due to the advancement in technologies. Generally, IoT is a technology where based on sensor data, the computer can access the data from any aspect without any human interaction. IoT concept came into the picture in order to overcome the problem like data accuracy and related parameters when data were collected through human interference. Traditionally, the radio-frequency identification (RFID) and the wireless sensor networks were considered as the major techniques used in IoT. In recent researches, while designing the network, path selection remains to be major drawback or issue which results in less efficiency for the whole system. The research can be extended with the idea of developing a technique where we combine WSN along with image processing concepts. Here we employ certain advancement in path selection where we select the clusters through which data can be transmitted. This will improve the overall efficiency of the system. Data loss and computational time can be improved if an optimal path is selected for transmission. These techniques can be employed in various IoT applications like field monitoring, quality prediction etc. The research will be carried on MATLAB / NS2 interface.

Keywords: *Internet of Things (IoT), Wireless sensor networks, Path selection, Image Processing.*

1. BACKGROUND OF THE STUDY

In recent years, Internet of Things (IoT) has gained more importance in various fields due to the advancement in technologies. In general, IoT is a technology in which based on sensor data, the computer can access the data from any aspect without any human interaction (Gubbi, 2013). IoT concept came into the picture in order to address the problem like data accuracy and related parameters when data were collected through human interference. Traditionally, the radio-frequency identification (RFID) and the Wireless Sensor Networks (WSN) were considered as the major techniques used in IoT (Lazarescu, 2013).

WSN for IoT environmental monitoring applications is challenging. High reliability, low cost, and long maintenance-free operation are some advantages of WSN. At the same time, the nodes can be exposed to variable and extreme climatic conditions. The Internet of thing (IoT) has technological changes in information industry (Lazarescu, 2013). WSN is based on advanced technologies in which we communicate with the environment by sensing the properties nature (Al-Adwan & Al-D, 2012). The main application of WSN sensors are used to monitor physical or environmental conditions, such as temperature, pressure, and sound, etc. and pass their data through the network to the main location (Zanjireh & Larijani 2015). To effectively collect and process the data and information at IoT end nodes, a low-cost data acquisition system is necessary for IoT based information systems. For long-term industrial environmental data acquisition uses WSN (Deshmukh & Shinde, 2016). The network of the node that cooperatively senses and may control the environment, enabling interaction between persons or computers and the surrounding environment was described as a WSN.

2. PROBLEM DEFINITION

Lazarescu, (2013) proposed the functional design and implementation of a complete WSN platform that can be used for a range of long-term environmental monitoring IoT applications. The application requirements for low cost, a high number of sensors, fast deployment, long lifetime, low maintenance, and high quality of service are considered in the specification and design of the

platform and of all its components. Low-effort platform reuse is also considered starting from the specifications and at all design levels for a wide array of related monitoring applications. Path selection is one of the important algorithms in wireless sensor network which results in higher efficiency in the network. Path selection algorithm is not included in the existing paper, thus it results in less efficiency for the whole system.

3. AIM AND OBJECTIVES OF THE STUDY

3.1 Aim

The major aim of the research is to develop a novel approach for improving the communication performance in wireless sensor network using path selection algorithm.

3.2 Objectives

To achieve the above-mentioned aim, the research has following objectives:

- To explore the existing techniques and challenges in long-term environmental monitoring for IoT applications.
- To implement a path selection algorithm in WSN for improving the efficiency of IoT.

4. LITERATURE REVIEW

Environmental monitoring is a major application domain for wireless sensor networks. Yang & Li, (2010) proposed the design and implementation of low-power wireless sensor networks for long-term, autonomous, and near-real-time environmental monitoring applications. They have developed a suite of networking protocols to offer reliable data collection with extremely low power consumption. A network of several sensor nodes is deployed in a remote field station to monitor soil moisture along with other environmental parameters. The system is integrated into the Texas Environmental Observatory infrastructure for long-term operation. Also, the field performance results are presented to show the reliability and energy-efficiency of the network.

Recent advancements, such as the vision of the Internet of Things (IoT), the cloud computing model, and cyber-physical systems, provide support for the transmission and management of huge amounts of data regarding the trends observed in environmental parameters. Mois et al., (2017) proposed three different IoT-based wireless sensors for environmental and ambient monitoring such as one employing User Datagram Protocol (UDP)-based Wi-Fi communication, one communicating through Wi-Fi and Hypertext Transfer Protocol (HTTP), and a third one using Bluetooth Smart. All of the proposed systems offer the possibility of recording data at remote locations and of visualizing them from every device with an Internet connection, enabling the monitoring of geographically large areas. The development details of these systems are described, along with the major differences and similarities between them. The feasibility of the three developed systems for implementing monitoring applications, considering their energy autonomy, ease of use, solution complexity, and Internet connectivity facility are analyzed and revealed that they make good candidates for IoT-based solutions.

Rita & Xiao, (2016) presented a WSN system which is capable of sensing multiple environmental factors, collecting data from multiple dispersed sensor nodes and displaying the aggregated data in real-time. Each individual sensor node is capable of probing multiple factors, including temperature, humidity, atmospheric pressure, UV radiation, and geographical location. Sensor data are transmitted to a server, which then is stored into a database through Wi-Fi networks. Each sensor node is portable enough to be carried for personal use, enabling broad potential application of our system.

Postolache et al., (2014) proposed a wireless sensor network architecture that integrates low-cost sensing nodes and a low-cost multi parameters sensing probe for reliable monitoring of water quality parameters of surface waters such as lakes, estuaries, and rivers in urban areas. A particular attention is dedicated to the design of the conductivity, temperature and turbidity signal conditioning circuits, highlighting important issues related to linearisation, measuring dynamic range and low-cost implementation by using commercial off-the-shelf components and devices.

5. RESEARCH METHODOLOGY

In the proposed methodology, we employ certain advancement in path selection where we select the clusters through which data can be transmitted. This will improve the overall efficiency of the system. Data loss and computational time can be improved if the optimal path is selected for transmission. This technique can be employed in various IoT applications like field monitoring, quality prediction etc.

The main purpose of the WSN platform is to provide the users of the IoT application an updated view of the events of interest in the field using path selection algorithm. The tiered structure of the used platform was introduced by one of the first long-term outdoor WSN experiments for environmental monitoring and allows:

- A good functional separation of platform components for optimization according to application requirements.
- A cloud-based field data access to bridge the latency-energy trade-offs of the low power communication segments and the ubiquitous and fast access to field data for end users.

The sensor nodes are optimized for field data acquisition using on-board transducers and processing. Then these sensor nodes are clustering and select the best path to reach gateways using short-range RF communications, either directly or through other nodes.

The gateways process, store, and periodically send the field data to the application server using long-range communication channels. The application server provides long-term data storage, and interfaces for data access and process by end users. The platform should be flexible to permit the removal of any of its tier to satisfy specific application needs. The proposed framework is given below,

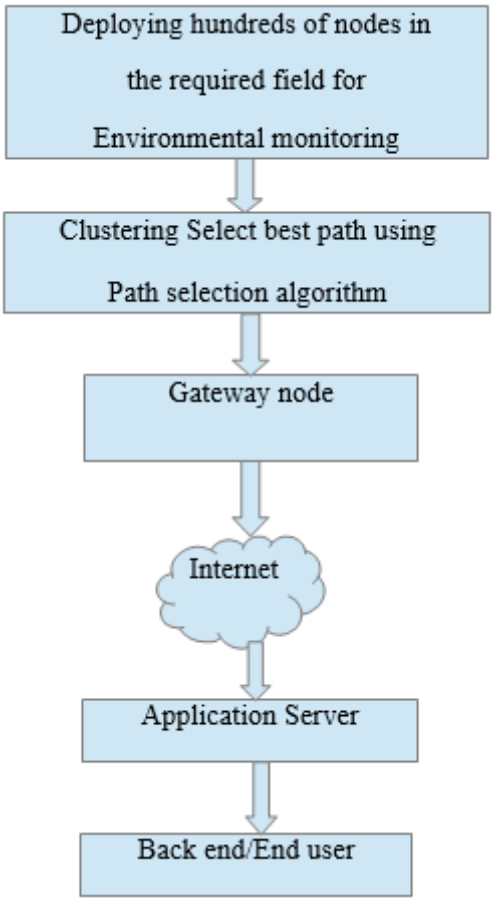

Fig. Proposed Framework

6. TOOLS OF RESEARCH

To evaluate the performance of the proposed research work a flexible evaluation tool is required. The performance analysis of proposed novel technique for improving the communication performance in WSN using path selection algorithm through MATLAB/NS2 interface.

7. PERFORMANCE EVALUATION

The following evaluation parameters are to be estimated for proving the superiority of the proposed research work.

- Throughput
- End-to-end delay
- Packet delivery ratio (PDR)
- Power consumption

8. SCOPE AND SIGNIFICANCE OF THE STUDY

The proposed research solves the issues in existing technique and improves the communication performance using path selection algorithm in Wireless Sensor Network (WSN) for IoT applications. The path selection algorithm achieves higher efficiency and used to long-term environmental monitoring applications.

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