INTERNET OF THINGS: MONITORING AND CONTROL OF AGRICULTURAL ACTIVITIES

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ABSTRACT

Internet of things is a technology that encounters various remote monitoring and controlling of devices, which is connected to it wirelessly. Here the concepts of wireless sensors networks and Ethernet protocols are made of use. This research paper mainly concerns its application towards agricultural and Irrigational activities such a soil moisture monitoring and water pressure monitoring and soil testing along with protection against trespassing with motion detections and conservation of energy. This research article mainly connected to one of the leading systems, and the rest three are the subsystems. This subsystem made with soil moisture monitoring control and water pressure sensing along with pump set and vibration alert sensor for motion monitor in and around the related field. The second subsystem will be in use for protection against trespassing with the detection of proximity of the object due to motion along the required field fence. It will have voltage and current detection sensors for controlling, monitoring efficient energy usage. Three subsystems use for controlling that is taking all possible measures by the available current status of the incorporated alerted sensors wherein users can control remotely access the sprinklers and measurable protective things like electrifying the fences and present activate status. The primary system contains the information from one and two the subsystem communicating through ZigBee communication and will be monitoring and transmitted to the network Router through ZigBee from where the required data displayed on to a web home page with necessary Ethernet protocols and current running data.

Keywords—*Internet of Things, Wireless Sensor Networks, ETHERNET, UART, Raspberry, ZIGBEE, IPv4, IPv6.*

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I. INTRODUCTION

Internet of Things (IoT) is advancement in technology wherein it makes use of Wireless sensor networks nanotechnology and Miniaturization. IoT is all about many physical devices interacting with each other may be person to person or machine to person further extended to things. Internet of things will provide seamless connectivity between the items in the virtual world with the real world, thereby ensures anytime, anywhere, anything communications. It helps people to make better decisions, such as taking the best routes to work or choosing their favorite restaurant. IoT intends to address challenges of society such as remote health monitoring for elderly patients and pay-as-you-use services.

In the future era of networked infrastructures for household appliances, IOT will act as a catalyst in the evolution of new generation services that will have a significant impact on the social and technological eco-system. IoT will help the user to approach various applications in a smarter way, which might be a smart home, smart agriculture, creative industries, or enterprise. IoT works with six Cs Connectivity, Communication, Collection, Convergence, Computing, and Content. The user can check the status of any resources in the network. It introduces IoT, which is the brain of this architecture and it controls web server and remote embedded system module there by the approach will be made smart simple and more reliable towards perfection. This project here designed to make agriculture smart to improve productivity and also protect the product loss or theft. IoT in use here will have its approach for the local network created and thereby monitor the status of embedded devices and take necessary measures passing commands controlling the devices which happen across the web server making use of Ethernet protocols.

2. BACKGROUND

3. Internet of Things is the network of physical devices, vehicles, home appliances, and other items embedded with electronics, software, sensors, actuators, and network connectivity, which enable these objects to connect and exchange data.
4. Wireless Sensor Networks: A wireless sensor network (WSN) is a wireless network consisting of spatially distributed autonomous devices using sensors to monitor physical or environmental conditions. A WSN system incorporates a gateway that provides wireless connectivity back to the wired world and distributed nodes.

5. **ETHERNET:** Ethernet is a family of computer networking technologies commonly used in local area networks, metropolitan area networks, and extensive area networks.
6. **Raspberry Pi:** The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and developing countries.
7. **ZigBee** is a wireless networking standard that aimed at remote control and sensor applications, which is suitable for operation in harsh radio environments and isolated locations. ZigBee technology builds on the IEEE standard 802.15.4, which defines the physical and MAC layers.
8. **IPv4:** Internet Protocol Version 4 (IPv4) is the fourth revision of the Internet Protocol and a widely used protocol in data communication over different kinds of networks. IPv4 is a connectionless protocol used in packet-switched layer networks, such as Ethernet. It provides a logical connection between network devices by providing identification for each device. Many ways to configure IPv4 with all kinds of instruments – including manual and automatic configurations – depending on the network type. IPv4 based on the best-effort model. This model guarantees neither delivery nor avoidance of duplicate delivery; these aspects handled by the upper layer transport.
9. **IPv6:** Internet Protocol Version 6 (IPv6) is an Internet Protocol (IP) used for carrying data in packets from a source to a destination over various networks. IPv6 is the enhanced version of IPv4 and can support huge numbers of nodes as compared to IPv4. It allows for 2¹²⁸ possible node, or address, combinations. IPv6 is also known as Internet Protocol Next Generation (IPN_g).

3. EXISTING WORK

There are numerous attempts made for the implementation of the Internet of things which were taken as reference for this following work. One such effort made is the Implementation of IoT for environmental condition monitoring at homes. This research main concentration on the four systems where in three subsystems in use for monitoring the ecological conditions at home, which might include temperature control, electric and solar water heater monitor system will also give way conservation of energy by current and voltage monitoring. The home automation method proposed can distantly measure electrical parameters and control domestic objects. The system comprehensively assists the inhabitants to avoid multiple systems to monitor their internal utilization. This system operated with the help of any of the smart devices such as laptops or i-pad. The basic layout depicting vital elements of the integrated WSN with an internet system consists of i) Smart Sensing devices, ii) IoT Gateway, and iii) Internet Server.

This system has its disadvantages every device status is monitored was not controlled accordingly for optimization of energy in consumption. When any of these devices are left uncontrolled, then they will pose a serious threat of damage or explosion. The advancements in technology expect that the availability of the internet is everywhere and online at all times. Low-cost smart sensor node development enabled devices to be connected quickly, and corresponding information can be accessed globally. The features of scalability, fault tolerance, and adequate

power consumption of nodes and transceiver IOT have facilitated ambiguity computational ability to internetwork heterogeneous smart devices easily and facilitate the availability of data anywhere.

4. PROPOSED SYSTEM

The implementation of IoT is here extended towards various agricultural activities, which make the user advance towards increased productivity. It has four systems one of which will be primary system, and the two other systems will be in use for monitoring the activities. The 4th system will be in use for taking necessary actions by the monitored status. Schematically the orders will be represented as shown below

Figure. : Main System and Sub System

Figure. : Subsystem working process

SYSTEM DESCRIPTION

The management of embedded devices such as sensors and motor, which is done remotely over the internet, is implemented with the following architectural design and with application of Zigbee communication standards. The data sensed by smart devices converged with Zigbee along the internet, which performed with the help of internet gateway for the given wireless sensor network. The collected by the monitoring devices is collected and sent to the coordinator over Zigbee wherein the translation of Zigbee protocol data format to IPV6 format is done at internet gateway.

The controlling operation proposed in this project completed with the help of the Arduino Uno processor, where the Ethernet shield will act as the translator of controlling data to Ethernet protocol standards and then controlled wirelessly with the help internet gateway.

Figure 1. : Practical working mechanism

The smart agriculture method proposed in this project will, therefore, help the user to monitor and control various activities wirelessly in a unified system and thereby reduce the complexity of multicasting of multiple systems. It can be achieved with the help of any of the smart devices laptops or smartphones. They are controlling switches, as shown in result.

C. ZIGBEE WIRELESS COMMUNICATION

Zigbee wireless sensor network will be of X2 module, and these will act as end devices for communication on transmitting as well as receiving end. This communication happens in the WSN with a mesh topology and could be altered by the application or with known sensor deployment in the network. The data packets can be transferred with single or multiple hops for routing and consequently reach the coordinator. The coordinator connected to internet gateway through wired LAN connection the router. The router with (OPENWRT) embedded source will access the internet, and interconnects Zigbee network to the IPv6 network.

D. SENSING UNITS

Since there are three subsystems, as shown below, figures will communicate with the Zigbee network with the coordinator. The sensors so deployed are classified into two units. Type 1 sensing unit will make use of Soil moisture, pressure sensor, and vibration sensor, which work on the application of monitoring irrigational activities. The sensing will be done periodically, with the duty cycle set. This is the control head for monitoring operation, which is performed as explained. This system will take in all the conjugated data. However, the Zigbee XS2 module and the data processed in a 32-bit microprocessor with threshold being set and is transferred as characters to internet gateway through UART (RS-232) as in figure 1.

SUBSYSTEM

I have Type 1 sensing units that are helpful in remotely monitoring. It consists of three sensors, which are Soil moisture, pressure, and vibration. These are placed according to user requirement as in the figure. These are digitized with ADC transmitted to primary system with necessary tools.

- Second subsystem will be of Type 2 sensors where the security concerns of the user and metering of energy addressed it includes Proximity(PrS), Current and voltage sensor which are analog again and thus movement across the field detected is converted to binary with precise values and then given away to primary system with Zigbee Xs2 module data format as in the figure. The same is true for current and voltage where a threshold value will be set as per user instruction and monitored accordingly.
- The third subsystem is quite different from the above two as it will not send or receive any data with primary system. This will act as its control head where the user will control necessary actions for monitored data; the Arduino microcontroller will perform actions of controlling whereas the Ethernet shield will host webpage which has a moisture sensor, Pressure sensor and Vibration sensors will work with 2mA input of DC 5v to 2v. The soil moisture will be in test consistently, but the data will be accessed periodically. The Pressure sensed when the respective equipment mounted when turned on.
- Type 2 sensing unit use Proximity Sensor (Prs), Current and Voltage Sensor where Prs will come in for safety application detects any movement in the proximity. The Current and Voltage will have energy conservation applications. PrS sensed and analyzed continuously. Similarly, Current and Voltage will be on for its devices intact on the operation.

E. CONTROL UNITS

This research work with Adriano processor and Ethernet shield for wireless control. It includes two controlling one will be for switching on the Sprinklers in response with soil moisture monitor and the other is fence control for safety concerning PrS. It will require a Power supply of its own and separate router access as it works with the individual IP address for that session connected devices.

F. INTERNET GATEWAY

Considered to be IOT application gateway that will perform the job of translation of packets of transmission from Zigbee standard to webpage supportive IPv6 standard. The to which coordinator is wired with will be buried with a program that will transform Zigbee addresses and Data Ethernet protocol. The sensed data packets form Zigbee are encapsulated with its corresponding address and converted to IPv6. The gateway with User datagram protocol (UDP) will connect with the server and thereby helps in wireless communication. The control packets from the server converted to an Ethernet shield compatible by the internet gateway.

ADDRESS TRANSLATION

Since subsystems communicate with the primary system through Zigbee protocol and we are displaying this monitored data through TCP Client, we must convert this received data, which is in Zigbee frame format to the Ipv6 frame format.

Figure.4: IP Network address

We know that in any given Zigbee network, only one Zigbee coordinator should be present, and there can be any number of Zigbee router or Zigbee end devices. The Zigbee coordinator will create a channel through which the end device can connect to it and can communicate through that channel. Each Zigbee coordinator will have its PAN ID. The sensor deployed in this case will become the Zigbee End Device(ZED). When these devices send their data in the channel created to the Zigbee coordinator, it will append its PAN id to the address to which the End Device is assigned. The End devices address will be 64 bit wide, and the PAN id will be 16 bit wide after appending the addresses; the total length becomes 80 bit wide.

The PAN id will be used by the Zigbee Router to communicate with the coordinator, and the addresses of the end devices will be used to communicate with the sensor nodes. After appending the Pan id to the end device ID, the coordinator sends this frame to the Zigbee router. It should be noted that each router will have its network ID. The network ID will be 48 bit wide, and when this is appended with the PAN id and the END device addresses, the total length becomes 128 bit wide. This 128-bit wide address is nothing but the Ipv6 frame packet, which is used to display the incoming data in the TCP. It is the IOT application Gateway (Router) that is taking part in appending the Network ID to the PAN ID.

5 CONCLUSION

This implantation of IoT will ease the user in monitoring and control of embedded devices remotely. This separation of monitoring and control subsystems will make the user handle the tools individually as per his needs or by monitored status. The energy metering has also been extended to different fields such as smart border security, Industrial automation, and a deficient cost home automation device. As the implementation referred with IPv6 frame format, the existing conversion to IPv4 format is to be employed. Network monitoring done by the reliability of WSN, resource management, and deployment factors. Thus web page crash can be avoided, and the method would be made more reliable.

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