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Home Automation Using Multinode Cooperative Network

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Abstract: *Home monitoring can be implemented in a low-cost manner using this proposed project. The existing system involves high-cost equipment which cannot be utilized by a normal person. In the proposed model the overall design of home monitoring uses the multinode co-operative network. It mainly focuses on the development of the home monitoring system which can be implemented using NodeMCU. The highlight of the project is to use the NodeMCU embedded with Wi-Fi technology which enables the transmission of the sensed data to the cloud. The Proposed model will monitor the working status of various equipment in the home. Based on the data sensed from the equipment the information is shared in a cooperative manner with the remote monitoring unit. The Amplify and Forward cooperative protocol is used to transmit the data to the destination. The main advantage of the cooperative network is to enhance the signal reception quality and to improve the monitoring of the status round the clock. A popular open-source platform to execute the process of transmission, processing, and receiving data without losing the intensity. We are going to use multiple nodes to decrease the fault while working with them. These node MCUs are used for many projects as it is very cheap. It also has integrated support for the Wi-Fi network. Its compact size is an added advantage. It has low energy consumption property and reliable secure cloud storage. They have a user-friendly programming environment and a scripting language that is easy to learn. These are mainly used in IoT home automation, security alarms, incubators, controller, Internet smoke alarms, serial port monitors, and VR trackers.*

Keywords: NodeMCU, co-operative network, amplify and forward, IoT

I. Introduction

To design and develop a system that will improve the signal reception quality and improved monitoring status round the clock using the Amplify and Forward Cooperative Protocol in NodeMCU. Cooperative Protocol in NodeMCU. Home Monitoring can be implemented in a low-cost manner using this proposed project. The existing system involves high-cost equipment which cannot be utilized by a normal person. In the proposed model, the overall design of Home Monitoring using Multinode Co-operative Network mainly focuses on the development of the Home Monitoring System which can be implemented using NodeMCU. The highlight of the project is to use NodeMCU embedded with Wi-Fi Technology which enables the transmission of sensed data to the cloud.

II. Cooperative Network

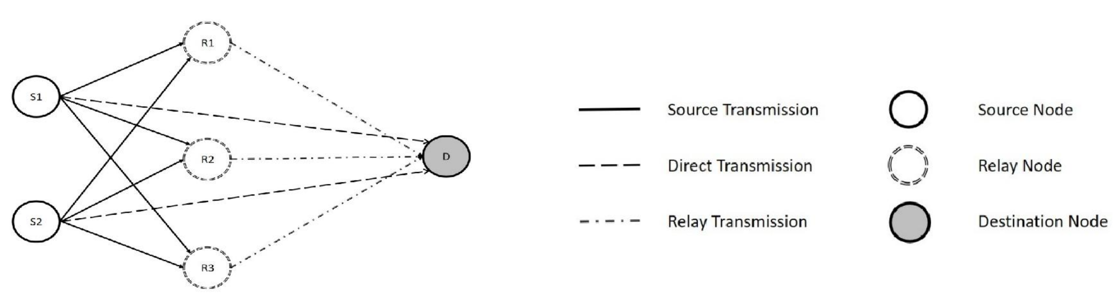

Figure 1: Cooperative Network Model

Amplify and forward protocol is also called the degenerative protocol. In a degenerative system, the relay terminals amplify the signal from the source terminals without any decoding. Amplify and forward protocol receives the signal from the source node, amplifies the signal, and forward the signal to the destination node in two phases [10]. In phase 1, the data is transmitted to the destination node and the other nodes in the network. Other than the source (s) and the destination (d) nodes all other nodes serve as fixed relays in AF cooperative network. In Phase 2, the relay node amplifies the data received from the source and forwards it to the destination. The destination node receives the signal from the source which is not in Line of Sight and also from the relays, which are in cooperation with the source and the destination nodes. Finally, using the Maximum Ratio Combining (MRC) Technique, the received data is optimally combined in the destination [11, 12]. In MRC the received signal is multiplied with the complex conjugate of the channel gain to maximize the output. The transmission power is considered to be the same in the source and in the relay. By this protocol, the data rate can be improved and better signal strength is achieved. The whole scheme toil on spatial multiplexing. An immersive wireless technology named MIMO (Multiple Input Multiple Output) is used here [3]. The basic idea of cooperative MIMO is to group multiple devices into a virtual antenna array to achieve MIMO communications. A cooperative MIMO transmission involves multiple point-to-point radio links, including links within a virtual array and possible links between different virtual arrays.

III. FORMULA

The received power $\boldsymbol{y}$ in the first phase of transmission, is given in equations (1) and (2),

The received signal from the Source to the Relay

$$y_{sr} = \left(\sqrt{P_s} h_{sr} x_{data}\right) + n_{sr} \tag{1}$$

The received signal in the direct path from the Source to the Destination

$$y_{sd} = \left(\sqrt{P_s} h_{sd} x_{data}\right) + n_{sd} \tag{2}$$

where, $\sqrt{P_s}$ denotes the source transmission power, the $h_{sr,}$ and h_{sd} represent the fading coefficient in the source to relay path and source to destination path respectively. The n_{sr} and n_{sd} are assumed to be an additive white Gaussian noise(AWGN) with zero mean complex Gaussian with variance number, assuming the receiver and transmitter are independent [13].

In the second phase of the transmission, the received signal is amplified by the relay node by a factor of β and transmitted to the destination node.

The signal received at the destination from the source via the relay is

$$y_{rd} = \beta h_{rd} y_{sr} + n_{rd} \tag{3}$$

The amplification factor[6]

$$\beta = \frac{\sqrt{P_r}}{\sqrt{P_s |h_{sr}|^2 + N_o}} \tag{4}$$

The received signal in terms of the transmitted data,

$$y_{rd} = \frac{\sqrt{P_s P_r} h_{sr} h_{rd} x_{data}}{\sqrt{P_s |h_{sr}|^2 + N_o}} + \frac{\sqrt{P_r} h_{rd} n_{sr}}{\sqrt{P_s |h_{sr}|^2 + N_o}} + n_{rd} \tag{5}$$

The signal received at the destination is from the source and the relay is combined using the maximum ratio combining technique to achieve an optimal output [14].Inspite of the fading in the free space the signal received in the destination node will be of good quality due to the signal received from the multiple nodes in the destination. The cooperative network serves as a virtual MIMO network considering the antenna in each node contributing the signal same as the elements in the MIMO network. The signal combining technique in the destination node improves the SNR in the receiver side as well as the throughput.

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IV. System Model

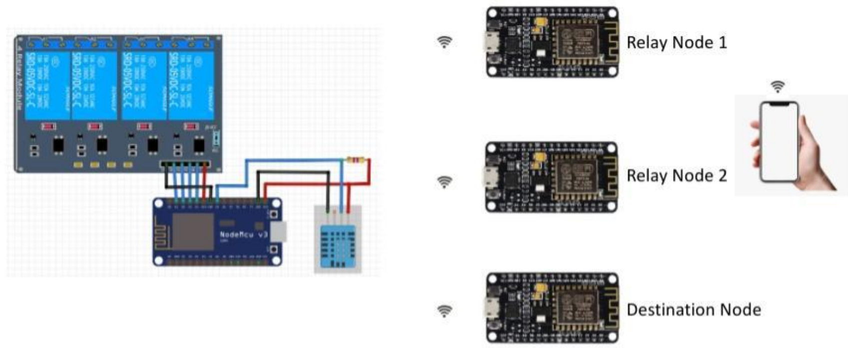

Figure 2: System Model of the proposed work

V. System Implementation

- Firstly, one ESP8266 (NodeMCU) is used as the Source Node which is connected to the DHT11 Sensor and a 4 Channel Relay Module.
- The Source Node sends the sensor data to 2 Relay Nodes (NodeMCU) and the Destination Node(NodeMCU) using ESP-NOW Protocol.
- Both the Relay Nodes amplify the received data packet from the Source Node and forward it to the Destination Node using ESP-NOW Protocol.
- The Destination Node receives the data transmitted from the Source Node and 2 Relay Nodes.
- The received data packets are synchronized in the Destination Node.
- The Destination Node is connected to the Wi-Fi Network and is also connected to the Blynk Cloud.
- The received data is displayed on the Blynk Devices Dashboard.

The 4 Channel Relay Module which is interfaced with the Source Node can be controlled from the Blynk Dashboard.

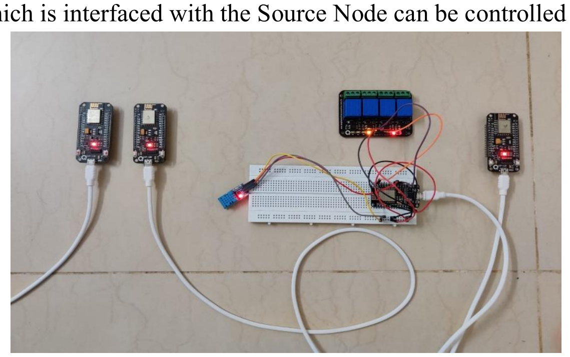

Figure 3: Implementation of Proposed System

VI. Results and Discussion

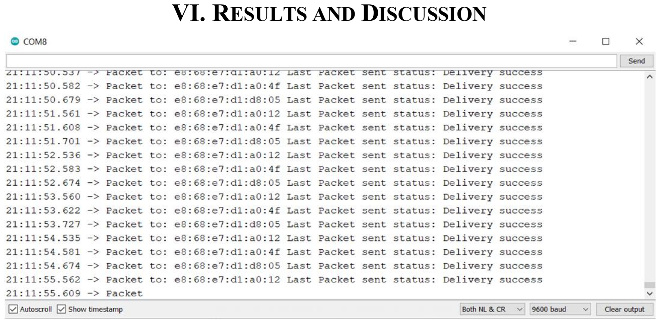

Figure 4: Source Node Serial Monitor Output

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In Figure 4, the Packet sent status for the Relay Nodes, and Destination Node from the Source Node is shown.

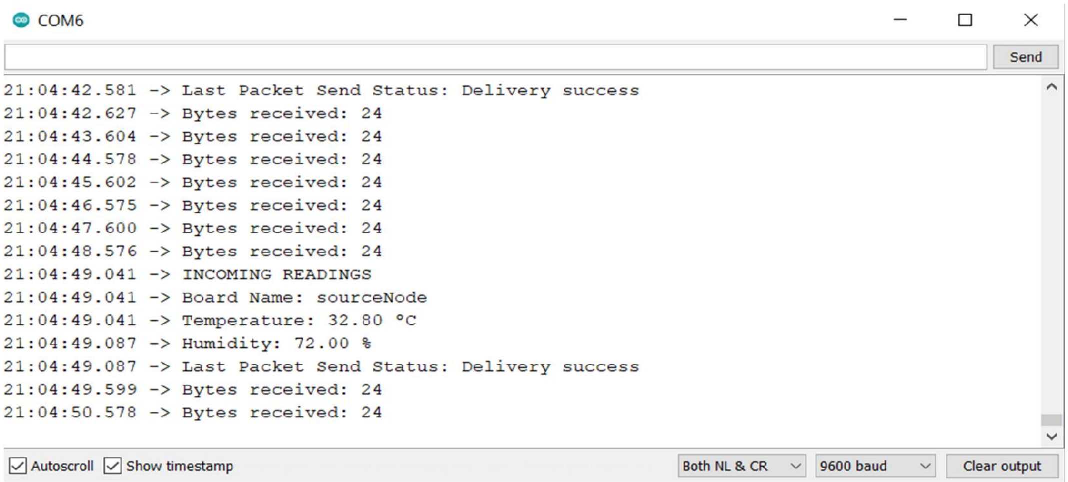

Figure 5: Relay Node Serial Monitor Output

In Figure 5, the incoming readings from the Source Node are displayed on the Serial Monitor and the Packet sent status for the Destination Node is shown.

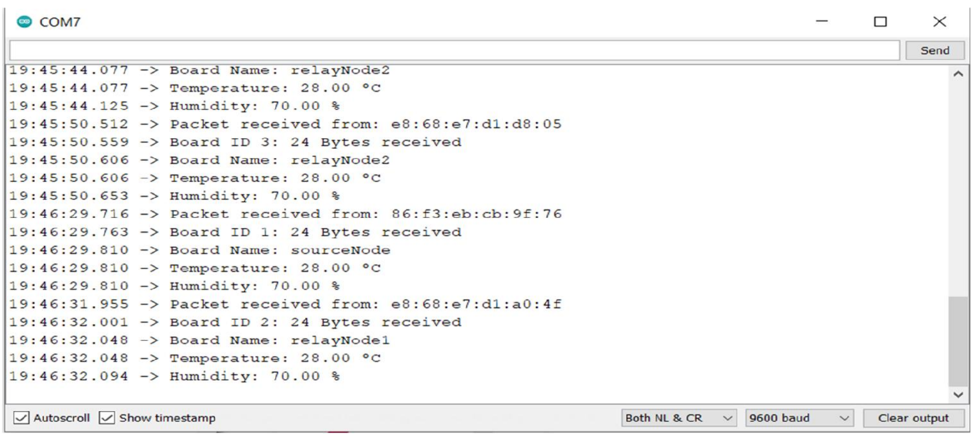

Figure 6: Destination Node Serial Monitor Output

In Figure 6, the MAC Address, Board Name, and the Sensor Readings received from the corresponding nodes are displayed.

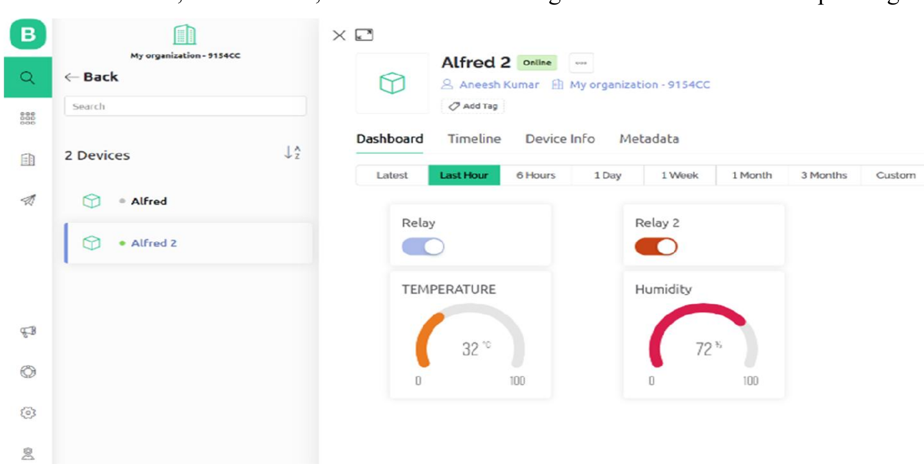

Figure 7: Blynk Dashboard

In Figure 7, the Sensor readings collected from the Source Node are displayed on the Blynk Webpage and Blynk IoT Application. The proposed system was designed and implemented successfully. The programs for the Source Node, Relay Nodes, and Destination Nodes are written, compiled, and flashed using Arduino IDE 1.8.19. The output is successfully displayed on Blynk Dashboard and Blynk IoT Application. The sensed data from the source node is transmitted to the destination node via the relay node along with the direct path transmission. The data sent is received at the destination successfully with good signal strength.

VII. Conclusion

In a large network, where the source and the destination are far apart, the relay nodes provide the best cooperation in the transmission of a signal between the source node and the destination node. The cooperative network concludes that without the expense of establishing a MIMO communication system, spatial diversity is achieved with the cooperative nodes. From the results, it was observed that the cooperative network outperforms the direct link transmission of a signal between the source and destination node.

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References

[1]. Panda K. G., Agrawal D., & Hossain A. (2016). Virtual MIMO in Wireless Sensor Network–Survey, IEEE Intl. Conf. on Green Engineering and Tech., http://doi.org/10.1109.

[2]. X. Zhang, M. Hasna, A. Ghrayeb (2012). Performance Analysis of Relay Assignment Schemes for Cooperative Networks with Multiple Source-Destination Pairs. IEEE Trans. Wireless Commun., 11(1),166–17.

[3]. Y. Bhute, A. R. Raut (2013). A Survey on Relay Selection Strategies in Cooperative Wireless Network for Capacity Enhancement. Intl. J. of Computer Appln., 65(25), 12–17.

[4]. Z. Rafique, B. Seet, and A. Al-anbuky (2013). Performance Analysis of Cooperative Virtual MIMO Systems for Wireless Sensor Networks. Sensors Journal., 13(6),7033–7052.

[5]. Isha, Varsha (2015). Study on Co-operative Communication for Energy Efficient Routing in Wireless Sensor Network. International Journal of Science and Research (IJSR),5(8),297-300.

[6]. R. A. Khan, M. A. Aleem, and A. A. Shaikh (2012). Performance Analysis of Cooperative Communication Protocols. Journal of Emerging Trends in computing and information Sciences.,3(7),1103–1127.

[7]. Qian Li, Rose Qingyang Hu, Yi Qian, Geng Wu (2012). Cooperative Communications for Wireless Networks: Techniques and Applications in LTE – Adv. Systems. IEEE Wireless Commun.,19(2), 22-29.

[8]. O. Bello, H. Zen, A. Othman and K. A. Hamid (2015). Computing Amplify-and-Forward Relay Amplification Factor to Improve Total Capacity at Destination. American Journal of Applied Science, 12, 572-580.

[9]. Suman Rathore, Priyanka Mehta, Kapil Gupta (2013). Performance Analysis of Cooperative Communication Network with Relay Selection over Rayleigh Fading Channel, Intl. J. of Computer Appln., 68(25), 48-51.

[10]. J. Wu, Y. D. Zhang, M. G. Amin, and M. Uysal (2012). Multiple-relay selection in amplify-and-forward cooperative wireless networks with multiple source nodes. EURASIP Journal on Wireless Communications and Networking, 1(256), 1–13.

[11]. D. B. da. Costa and S. Aissa (2009) Performance of Cooperative Diversity Networks: Analysis of Amplify and Forward Relaying under Equal-Gain and Maximal-Ratio Combining. IEEE Intl. Conf. on Commun., 1-5.

[12]. H. Katiyar, A. Rastogi, R. Agarwal, H. Katiyar, A. Rastogi, and R. Agarwal (2011). Cooperative Communication : A Review Cooperative Communication : A Review. IETE Technical Review, 28(5).

[13]. C. Paper, K. E. Macdonald, and K. El-darymli (2010). Amplify-and-Forward cooperative relaying for a linear Wireless Sensor Network. IEEE Intl. Conf. on Common on Systems Man and Cybernetics (SMC), pp. 106 -112

[14]. K. J. Ray Liu, Ahmed K. Sadek, Weifeng Su, and Andres Kwasinski(2009) Cooperative Communications and Networking, Cambridge University Press,135 – 141.