VLC Based Contextual Indoor Navigation System using Arduino

Y.Anitha [#]

[#]*ECE, Anna University, Jeppiaar Engineering College*

Abstract: **As of now, indoor localization and navigation system are practically viable and easy to implement and are not used in real time. Various technologies like RFID, ZigBee have been suggested but they all have serious drawbacks and are not practical because of many reasons. In this project we propose an indoor navigation and information system that is easy to implement and use, because it uses (VLC), which is the ideal technology for an application like this. The principle of this project is that visual light in indoor environments can be used for digital data communication. A prototype navigation** and **information system will be implemented for large shopping malls, but the same can be used in many other places like government offices, hospitals, tourist attractions, museums and even in institutions and colleges** in **this project**.**The project has two parts: one is the fixed lighting in a building which in addition provides lighting to the building and is also transmitting information related to that part of the building and also navigation information for a user to find out where they are and how they can get to any place they want to go to.**

Keywords: VLC- Visual Light Communication, RFID- Radio-frequency identification, , ZigBee- IEEE 802.15.4-based specification for a suite of high-level communication protocols.

I. INTRODUCTION

When multiple antennas are used at the source, transmit diversity can be achieved by using Space time block codes (STBCs). However, STBCs require multiple antennas associated with (RF) radio frequency chains which are costly in terms of size, power, and hardware. To solve this problem, low-cost and low-complexity transmit antenna selections (TASs) schemes with STBCs have been introduced. Cooperative relay systems utilize two independent source destination (SD) and source-relay-destination (SRD) paths. To select good transmit antennas at the source, we have to consider both the SRD and SD paths simultaneously. Decode and Foward relay networks of one source, one destination, and N relays with MS, MD and MR antennas respectively. Assume that the relay-destination (RD) channels are orthogonal and decreases the data transmission rate. The reason for this assumption is that if the relays transmit signals by the same channel, the potential maximum diversity may be difficult to achieve. STAS (Source transmit antenna selection) of selecting antennas at the source is based on the upper bound on the Pairwise error probability (PEP). At the destination the STAS can be performed, and then the information on the selected transmit antenna is fed back to the source. In the first phase, the source transmits an uncoded single symbol or a codeword of a full-diversity STBC with transmit antennas. During the second phase, the relays decode, re-encode, and re-transmit signals from antennas, and so the relays may transmit erroneous signals. Finally, the destination decodes the received signals from the source and the relays by using the Energy efficient algorithm scheme.

II. PROPOSED SYSTEM

In this work, STAS using upper bound on PEP scheme and DF using Energy efficient (EE) algorithm is to be studied, EE algorithm is a finite set of steps that are used with a system in order to reduce energy consumption when number of relay nodes increases for consuming the more power to transmit the signal, the EE provide a solution that may be far from optimal. In existed system, Maximum likelihood (ML) decoder is used in relay for decoding the signal. ML decoder is difficult to design and delay in processing and also decreasing the performance of diversity gains. EE algorithm is used in relay for improving the performance of diversity gain and decrease the delay in processing. Energy consumption of relay node can be solved with the EE, it also propose to achieve diversity gain and throughput and decreases the power of relay node without scarifying system performance.

III. CONCEPTS INVOLVED

For the selection of good source antennas considering both the SD and SRD paths simultaneously. Unlike AF relay networks, it is difficult to find the optimal solution for the SAS in the DF relay networks due to the difficulty in deriving their error probabilities. Instead, the union bound on BEP can be used as a criterion of selecting good source antennas by deriving PEPs. However, it is still difficult to derive the exact PEP. Number of relay can be increased, so power consuming of each relay can be increased. To reduce the power allocation of relay by using EE algorithm in each relay networks. Not only reducing the power allocation of relay networks and also increasing the diversity gain and throughput without scarifying system performance.

IV. MULTIPLE INPUT MULTIPLE OUTPUT

(MIMO) In radio, Multiple-input and multiple-output (MIMO) is the use of multiple antennas to improve communication performance at both the transmitter and receiver. It is one of smart antenna technology. MIMO technology has been involved attention in wireless communications, because it offers momentous increases in data throughput and also the link range without additional bandwidth or increased transmit power. The goal has been achieved by scattering the total transmit power over the antennas to achieve an array gain that improves the spectral efficiency to achieve a diversity gain that improves the link reliability (reduced fading).

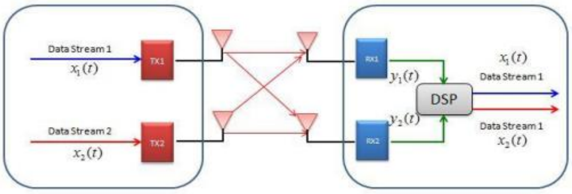


Fig 1 Multiple input multiple output

V. FUNCTIONS OF MIMO:

MIMO can be sub-divided into three main categories, Precoding, Spatial multiplexing, and Diversity coding.

VI. RELAY NETWORK

A relay network is a broad class of network topology commonly used in wireless networks, where the source and destination are unified by some nodes. In such a network the source and destination cannot communicate directly because the distance between the source and destination is greater than the transmission range. Hence the want for intermediate node to relay. Relays that receive and retransmit the signals between base stations and mobiles. They can increase throughput and extend coverage of cellular networks. Infrastructure relays do not want wired connection thereby offering savings in operators‘backhaul costs. Mobile relays can be used to eract local area networks between mobile users under the umbrella of the wide area cellular networks. Furthermore, relays can operate in half-duplex mode, or in full-duplex mode. The second operation requires a spatial separation between transmit and receive antennas to reduce loop-back interference from the transmit antennas to the receive antennas. The base-station (BS) can receive signals from two handsets (or nodes or mobile stations). One handset is the source node and the other is the relay node. The BS receives those two handsets‘signals to obtain the cooperative diversity.

VII. ANTENNA SELECTION

Multiple-antenna systems, also known as multiple-input multiple output radio, can improve the capacity and reliability of radio communication. Antenna selection is a low-cost low-complexity alternative to capture many of the advantages of MIMO systems. Antenna selection can be broadly classified into Receive antenna selection and Transmit antenna selection.

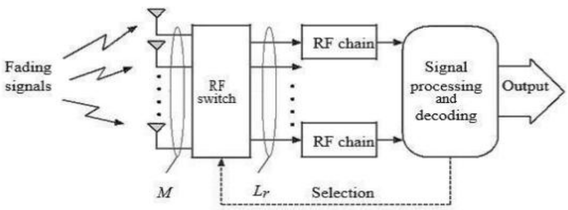


Fig 2. Transmit antenna selection

VIII. ANTENNA SELECTION ALGORITHM

It has been shown that it is possible to improve the performance of multiple-input multiple-output (MIMO) systems by employing a larger number of antennas than actually used and selecting the optimal subset based on various criteria is known as antenna selection. Antenna selection algorithms assume perfect channel knowledge and optimize criteria such as Shannon capacity, channel state information or various bounds on error rate to select the optimal set of antennas.

IX. SOURCE TRANSMIT ANTENNA SELECTION

Source antenna selection (STAS) algorithm selects an effective transmit antenna based on the source to destination wireless link. However, links from source to destination, source to relay, relay to destination should be considered when implementing antenna selection in MIMO relay systems. Selecting one transmit antenna out of multiple antennas at source and relay to send a single spatial data stream in the non-regenerative MIMO relay channel, to achieve diversity.

X. QUARDRATURE AMPLITUDE MODULATION

(QAM) Quadrature amplitude modulation (QAM) is both an analog and a digital modulation scheme. The modulated waves are summed up, and the resulting waveform is a combination of both phase-shift keying (PSK) and amplitude-shift keying (ASK).

XI. CHANNEL

In telecommunications and computer networking, a communication channel is a physical transmission medium such as a wire, or a logical connection over a multiplexed medium such as a radio channel. A channel is used to send a digital bit stream, from one source to several receivers. A channel has often measured by its bandwidth in Hz or its data rate in second.

XII. ENERGY EFFICIENT ALGORITHM

- This section aims to increase the energy-efficiency of cooperative relaying. First analyze the packet complexity and energy consumption of a cooperative relaying protocol using distributed timers to select the best relay. We refer to this protocol as basic relay selection (RS basic) hereafter. The chosen this protocol because it minimizes the packet exchange during relay selection. The considerations do not regard for any MAC issues and focus solely on the selection process.
- To introduce two simple modifications to RS basic which increase the overall energy-efficiency as compared to the basic protocol: (i) Common neighbours of {S, D} determine if they are suitable relay candidates based on their channel qualities, (ii) D decides whether to enable cooperation based on the direct link quality RS basic employs pro-active relay selection, i.e., the destination D selects the relay prior to the data transmissions from S to D illustrates the

different phases of RS basic. The different phases of RS basic steps are given below,

- Node S transmits a ready-to-send (RTS) packet. Neighbours of S use this packet to measure the SNR between S and themselves.
- The destination D reacts with clear-to-send (CTS) packet transmission. Neighbours of D exploit this packet to obtain the SNR from them to D. Here, assume that if D transmits with the 35same power as Ci, i.e., the channel between D and node Ci has identical behaviour as the channel between Ci and D.
- After the transmission of RTS and CTS, only nodes which have received both packets are potential relaying candidates. Each candidate Ci, combines its measured to get an indicator of its suitability to act as a relay. Let the relaying suitability of candidate Ci. Determining the function that yields the ―best‖ relay is not straight forward.
- The question is how to find the best relay, given that every candidate only knows its own χi . Each Ci sets a timer to a value inversely proportional to its χi-value. Clearly, the timer of the best relay expires first. As soon as the timer expires, the corresponding node sends an apply-for-relay (AFR) packet. Every candidate overhearing the AFR transmission of the best node, stops its own timer and quits the cooperation process.
- The destination answers the reception of an AFR packet with select for-relay (SFR) packet containing the identity of the selected relay R. This packet accounts for hidden nodes among the relaying candidates, i.e., nodes which are not in transmission range of the best relay. The relay selection ends with the reception of the SFR packet.
- Note that D needs to use a time-out timer that expires after a specified time if no AFR packet is received. This timer avoids deadlocks in case of missing relays. If no relay exists, D informs S to start the data transmission without using cooperation. Node S starts its data transmission after the relay selection, i.e., after reception of the SFR. Node D and relay R listen to this transmission. If the destination is able to decode the packet correctly it answers with an acknowledgment (ACK). Otherwise, D stays silent indicating that it needs cooperation. In the case the direct transmission has failed and 36if R has successfully received the data from S, R forwards the data to D (triggered by a time-out event if no ACK transmission is observed).
- If R has failed to overhear the transmission from S, it quits cooperation In case D has not received the data from S and no relay was selected or R has not decoded the packet from S successfully, S starts a retransmission attempt, including a new relay selection. This scheme assumes that the coherence-time of the channel is longer than the entire time needed to select a relay R, transmit the data from S, and finally, forward the overheard packet from R to D. RS basic achieves a diversity gain that is equal to the number of relay candidates, i.e., the number of nodes that have received both packets RTS and CTS.
- Furthermore, it outperforms more complicated schemes using multiple relay nodes. Note that RS basic considers only packet transmissions for enabling cooperative relaying and does not consider any resource overhead reservation.

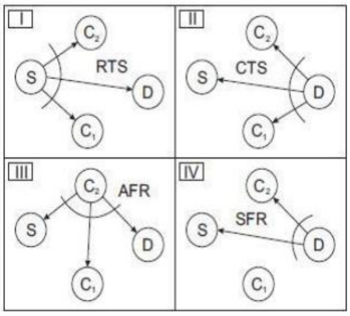


Fig 3 . packet exchange in RS basic

Formula used to calculate the energy consumed by a node when it receives and forwards kilobits

$$E_T(k,d) = \begin{cases} E_{T-elec}k + \varepsilon fs\, d^2 k, K \text{ when } (d \le d0); \\ E_{T-elec}k + \varepsilon mp\, d^4 k, K \text{ when } (d > d0); \end{cases}$$

$$E_R(k) = E_{R-elec}\,k$$

Where

$E_T(k,d)$ is energy consumed by a node of distance d

$E_{T-elec}k$ is energy tuning of k

$E_R(k)$ is energy consumed by receiver

K is number of message types

BLOCK DIAGRAM

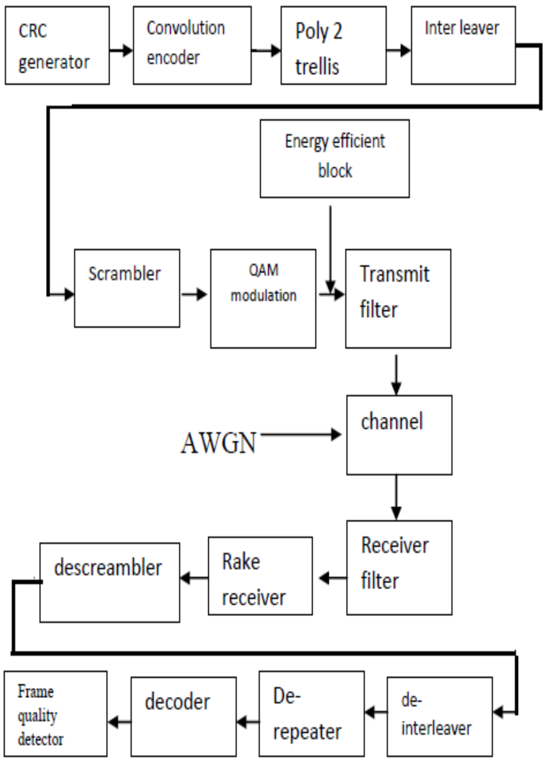
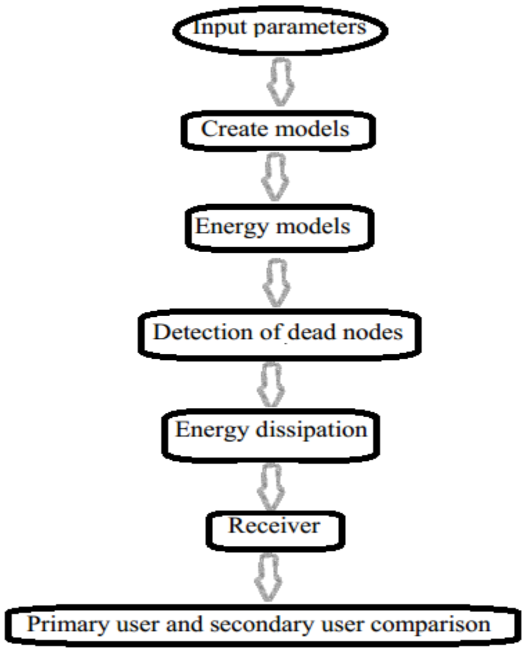


Fig 4. Block diagram

FLOW CHART



XIII. TECHNICAL EXPLANATION

Energy Harvesting: Energy harvesting (also known as power harvesting or energy scavenging) is the process by which energy is derived from external sources (e.g. solar power, thermal energy, wind energy, salinity gradients, and kinetic energy), captured, and stored for small, wireless autonomous devices, like those used in wearable electronics and wireless sensor networks. For example, temperature gradients exist from the operation of a combustion engine and in urban are as, there is a large amount of electromagnetic energy in the environment because of radio and television broadcasting.

THREE TYPES OF NODES: Normal node Sensing node Dead node Normal node is indicated by blue colour. Sensing node is indicated by blinking. This node shows energy harvesting from unused nodes.

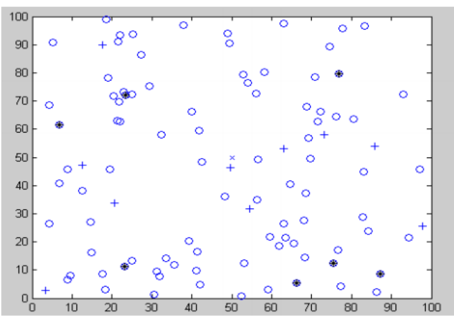


Fig 5. nodes

Dead nodes are indicated by red colour. This node refers that unused energy has been harvested by the neighbour nodes. Thus unused energy is efficiently used.

XIV. FORMATION OF DEAD NODES

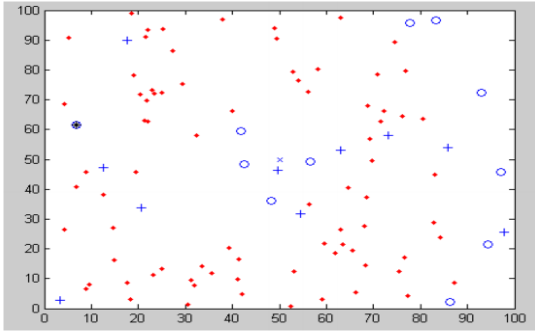


Fig 6. Formation of dead nodes

XV. CONCLUSION

The proposed Source antenna selection (SAS) for Decode and forward (DF) relay network can achieve the maximum diversity and throughput. Energy efficient (EE) algorithm linked with the relay network reduces the delay in decoding process and also the power of the relay. The simulation results showed that the proposed STAS has better average BEP performance than other existing STASs (MSS=1 and MSS=2). Surprisingly, the proposed STAS with MSS=1 has lower cost, lower complexity, lower overhead, and better BEP performance than the cases of MSS > 1.

XVI. FUTURE SCOPES

The work can be extended into Long term evolution (LTE) with multiple inputs multiple output (MIMO) technology in cognitive radio network by considering same parameters. Energy efficient algorithm reduces the power of each relay node and achieves the high data rate.

REFERENCES

[1]. S. Sanayei and A. Nosratinia, ―Antenna selection in MIMO systems,‖ IEEE Commum. Mag., vol. 42, no. 10, pp. 68–73, Oct. 2004.

[2]. A .F .Molisch andM. Z.Win, ―MIMOsystems with antenna selection,‖ IEEE Microw. Mag., vol. 5, no. 1, pp. 46–56, Mar. 2004.

[3]. I. Berenguer, X. Wang, and V. Krishnamurthy, ―Adaptive MIMO antenna selection via discrete stochastic optimization,‖ IEEE Trans.Signal Process., vol. 53, no. 10, pp. 4315–4329, Nov. 2005.

[4]. Z. Chen, J. Yuan, and B. Vucetic, ―Analysis of transmit antenna selection maximal-ratio combining in Rayleigh fading channels,‖ IEEETrans. Veh. Technol., vol. 54, no. 4, pp. 1312–1321, Jul. 2005.

[5]. H. Zhang and H. Dai, ―Fast MIMO transmit antenna selection algorithms: a geometric approach,‖ IEEE Commun. Lett., vol. 10, no. 11, pp. 754–756, Nov. 2006.

[6]. D. A. Gore and A. Paulraj, ―MIMO antenna subset selection with space-time coding,‖ IEEE Trans. Signal Process., vol. 50, no. 10, pp. 2580–2588, Oct. 2002.

[7]. Z. Chen, J. Yuan, B. Vucetic, and Z. Zhou, ―Performance of Alamouti scheme with transmit antenna selection,‖ Electron. Lett., vol. 39, no. 23, pp. 1666–1668, Nov. 2003.

[8]. D. J. Love, ―On the probability of error of antenna-subset selection with space-time block codes,‖ IEEE Trans. Commun., vol. 53, no. 11, pp. 1799–1803, Nov. 2005.

[9]. S. Peters and R.W. Heath, ―Nonregenerative MIMO relaying with optimal transmit antenna selection,‖ IEEE Signal Process. Lett., vol. 15, pp. 421–424, 2008.