Algorithm for Energy Efficient Sensor Network in Precision Agriculture

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Content

Introduction

- Shift in economic development and urbanization, significantly shrinking the farming land: putting a stress over farm land.
- Here we need a role of technology to surpass this problem.
- Precision agriculture: IoT based application of technology helping farmers decide:
  - What type of crops to be harvested?
  - How to get maximum output?
- Advancement in technology in agriculture saves time and cost of farmers.

Motivation

- An IoT based network mode let farmers fetch all the information in less time and with minimum efforts.
- Much attention has already been drawn over PA abroad, large scale use of IoT in agriculture is taking place.
- Hoping! India get to see next revolution with the technology assisted farming soon.
- Precision Agriculture consisting of sensors and actuators:needs power source.
- Battery becomes the heart for working and heart of volatility with the network.
- Efficient utilization of the available source is must.

Literature Review

Author Name	**Title**	**Techniques Used**	**Year of Publication**
Chu-Fu Wang, Jau-Der Shih, Bo-Han Pan, and Tin-Yu Wu	A Network Life-time Enhancement Method of Sink Relocation	MCP	2014
Sanat Sarangi, and Srinivasu Pappula	Adaptive Data-centric Clustering with Sensor Net-works for Energy Efficient	Data Mining	2016
O.Moussaoui, A.Ksentini, and M.Naimi	A novel clustering al-gorithm for efficient energy saving	MAC and TDMA	2006

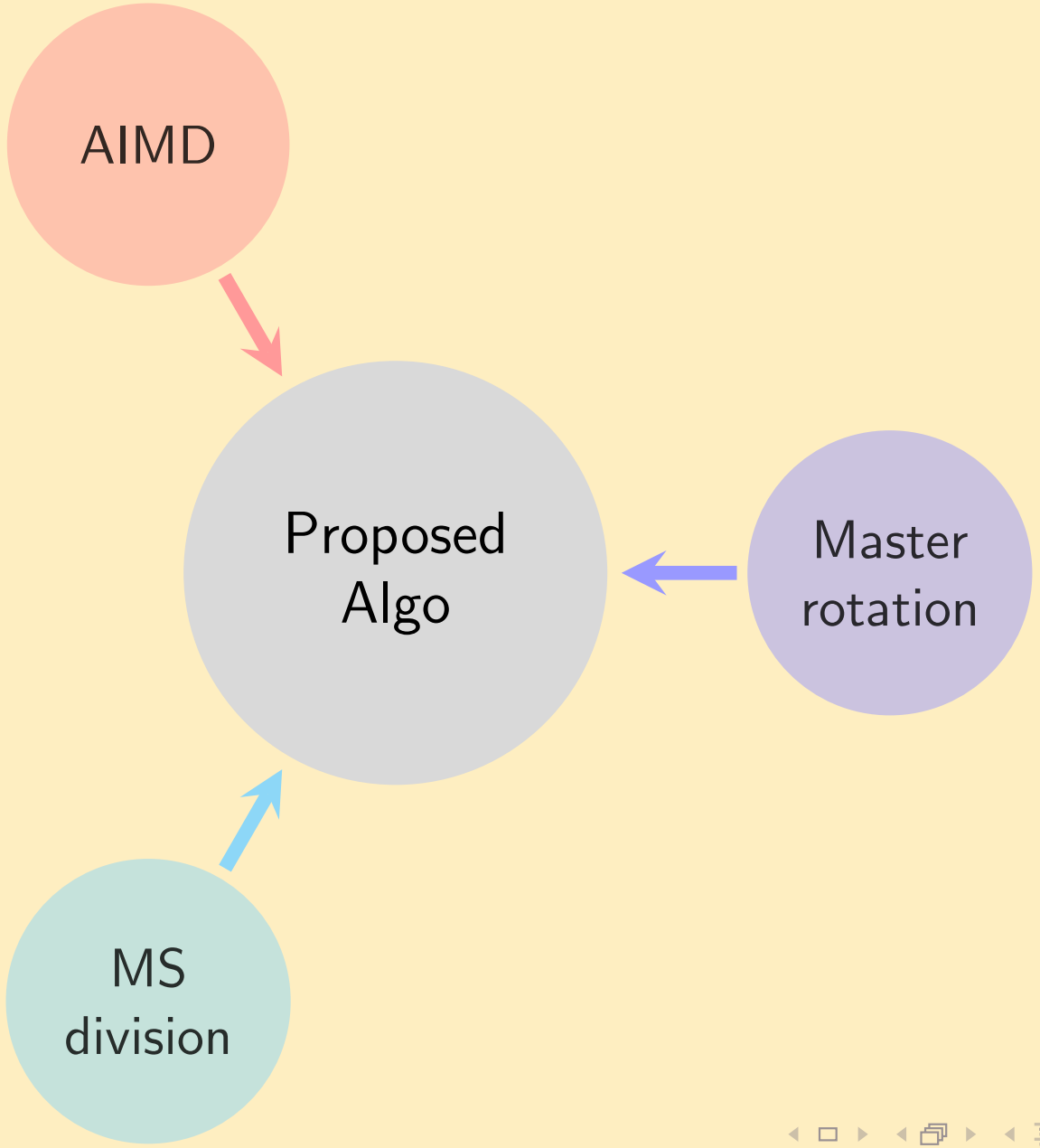
Problem Statement

- Using Master-Slave division along with Additive Increase-Multiplicative Decrease approach to enhance sensor network lifetime for Precision Agriculture

Tools

- TinkerCad
- Arduino UNO
- LEDs
- Resistors
- Multimeter
- Arduino IDE (C++)

Methodology



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- Master Slave division
  - Among the nodes,one node considered master and others as slaves at a time.
  - Master node sensing, more frequent than that of slaves.
  - Smallest interval:Master, Largest interval:Slave.

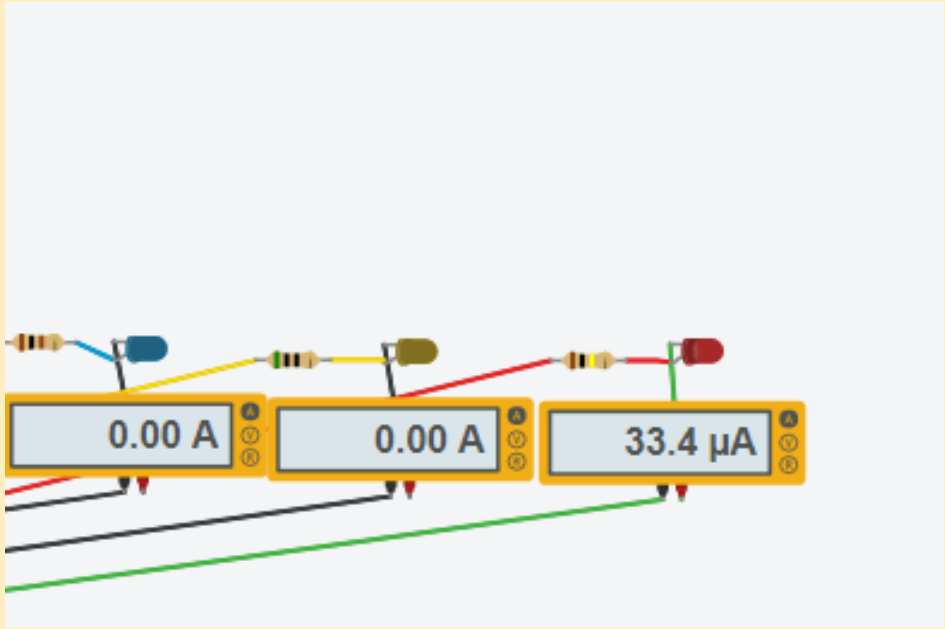

Figure: Temperature sensors: Master node

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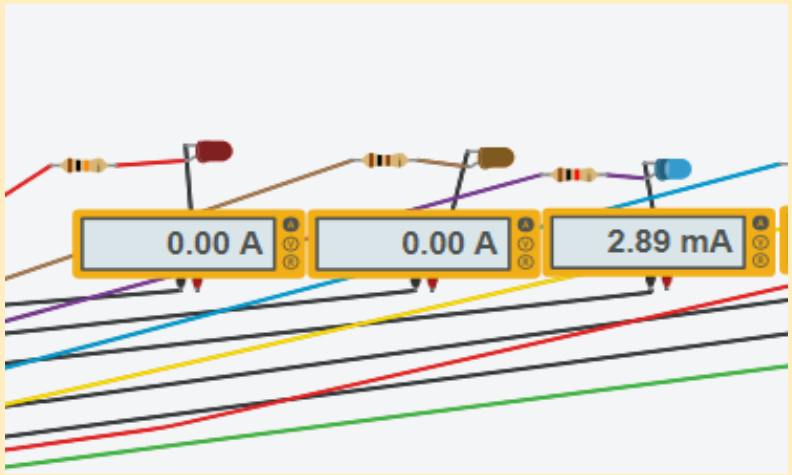

Figure: Di-electric: Master node

- Master rotation
  - Master node rotated within the nodes.
  - Battery level considered before making slave as the master node.
- Additive Increase Multiplicative Decrease
  - Sensed data compared with the Threshold Value.
  - AIMD implemented considering the Threshold Value.

Implementation

- Analogy Used
  - Circuit implementation of the problem circuit is done online on virtual environment tinkercad.
  - Different types of sensors used in precision agriculture offers different resistance.
- Why Analogy?
  - Analogy: used to eliminate possible physical errors.
  - Helps to measure the results of the proposed approach algorithm in simpler manner.

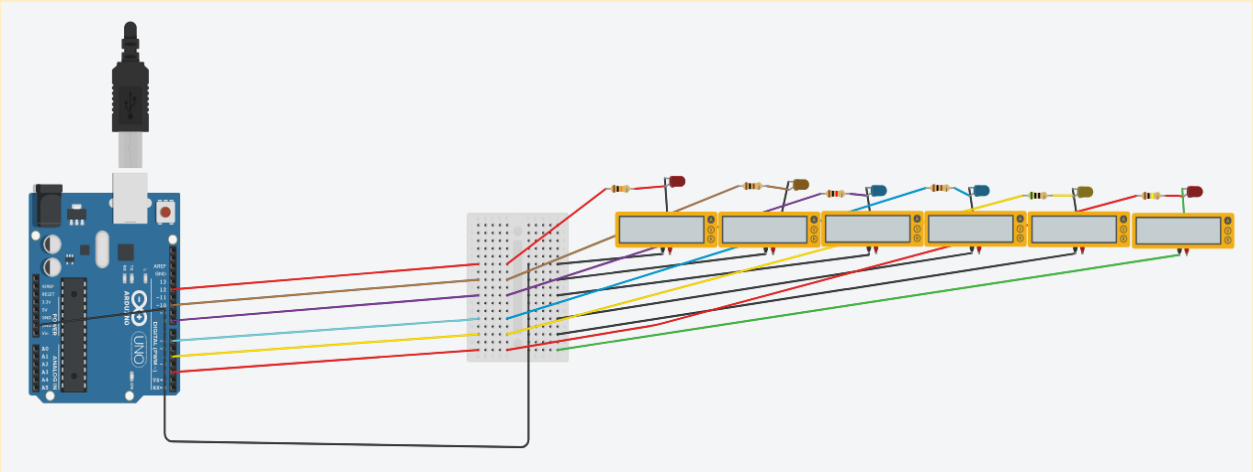

Figure: Analogy circuit

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- Working of the analogy
  - Arduino UNO works as the central node.
  - The LEDs in series with different resistors gives analogy to real time sensors.
  - ON LED:Sensor Active state, OFF LED: Sensor Inactive state.

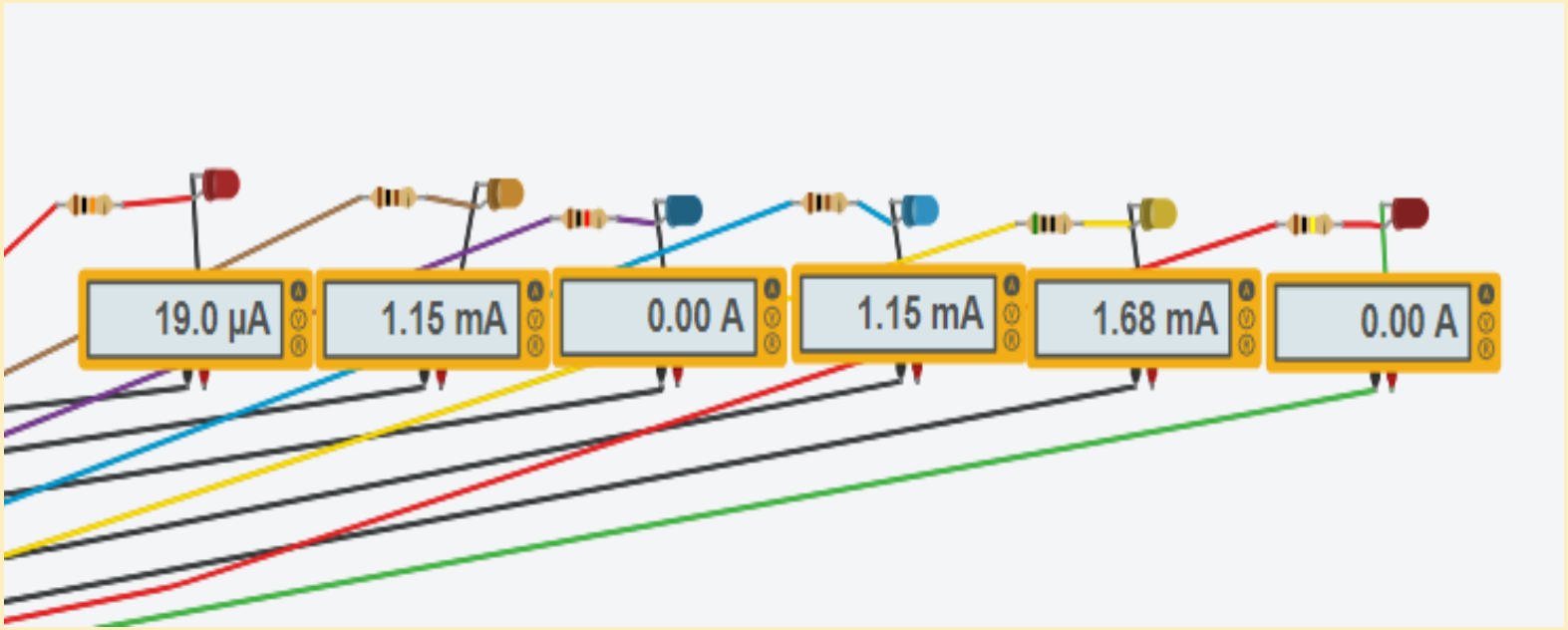

Figure: Slave nodes working

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- Historical data consideration
  - Nodes at 2,4,6 pins of arduino:Temperature sensors.
  - Nodes at 8,10,12 pins of arduino:Moisture sensors.
  - Master node checks every hour.
  - Slave nodes checks every two hour.
  - Additive increment time:20 minutes.
  - Master time period<= incremented time<=Slave time period
  - Multiplicative decrement time makes the increment time comes down to one hour again

Result

- TABLE: number of times a node gets activated in 6 hours duration.

Cases	**Approach**	**Node 1**	**Node 2**	**Node 3**	**Total**
A	!D !R !A	6	6	6	18
B	!D !R A	4	4	4	12
C	D !R !A	6	3	3	12
D*	D !R A	4	3	3	10
E	D R !A	6	3	3	12
F*	D R A	4	3	3	10

Contd...

- How much efficient is our algorithm?
- From above table:
  - Case A & Case F:

$$\frac{18-10}{18} \times 100 = 44.5\%$$

  - Case B or C & Case F:

$$\frac{12-10}{12} \times 100 = 16.67\%$$

  - Case E & Case F:

$$\frac{12-10}{12} \times 100 = 16.67\%$$

- Hence, we see implementing AIMD gives 0.16 times better efficiency.

Conclusion

- Conclusion
  - Novel clustering and cluster head rotation give a platform to energy efficiency approach.
  - We considered best possible scenarios in all possible cases.
  - We implemented our solution derived from novel clustering, sink relocation with AIMD, and observed better efficiency.

Future scope

- Future Scope
  - We implemented our algorithm for one cluster only i.e. one master node with slave nodes. This can further be implemented for multi-cluster network.

Contd...

- Chu-Fu Wang and Jau-Der Shih; A Network Lifetime Enhancement Method for Sink Relocation and Its Analysis in Wireless Sensor Networks, IEEE Sensors Journal, Vol. 14,pp. 1932-1943, 2014.
- Georg Ru and Alexander Brenning; Data Mining in Precision Agriculture: Management of Spatial Information, Springer-Verlag Berlin Heidelberg, pp. 350-359, 2010.
- V.I. Adamchuka, J.W. Hummel, M.T. Morgan, S.K. Upadhyaya; Computers and Electronics in Agriculture, Elsevier, pp 71-91, 2004.

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- Jeromina J and Dr. K. V. Anusuya; A Network Lifetime Enhancement Method for Sink Relocation and Its Analysis in Wireless Sensor Networks; IEEE Sensors Journal, Vol. 14, pp 1932-1943, 2014.
- Moussaoui, A. Ksentini, and M Naimi; A novel clustering algorithm for efficient energy saving in Wireless Sensor Networks, Seventh IEEE International Symposium on Computer Networks; pp 66-72.
- Sanat Sarangi and Srinivasu Pappula; Adaptive Data-centric Clustering with Sensor Networks for Energy Efficient IoT Applications, IEEE 41st Conference on Local Computer Networks, pp 398-405, 2016.

Thank You