

A Design of Wireless Sensor Network and its Protocols for Collecting Vehicle Data

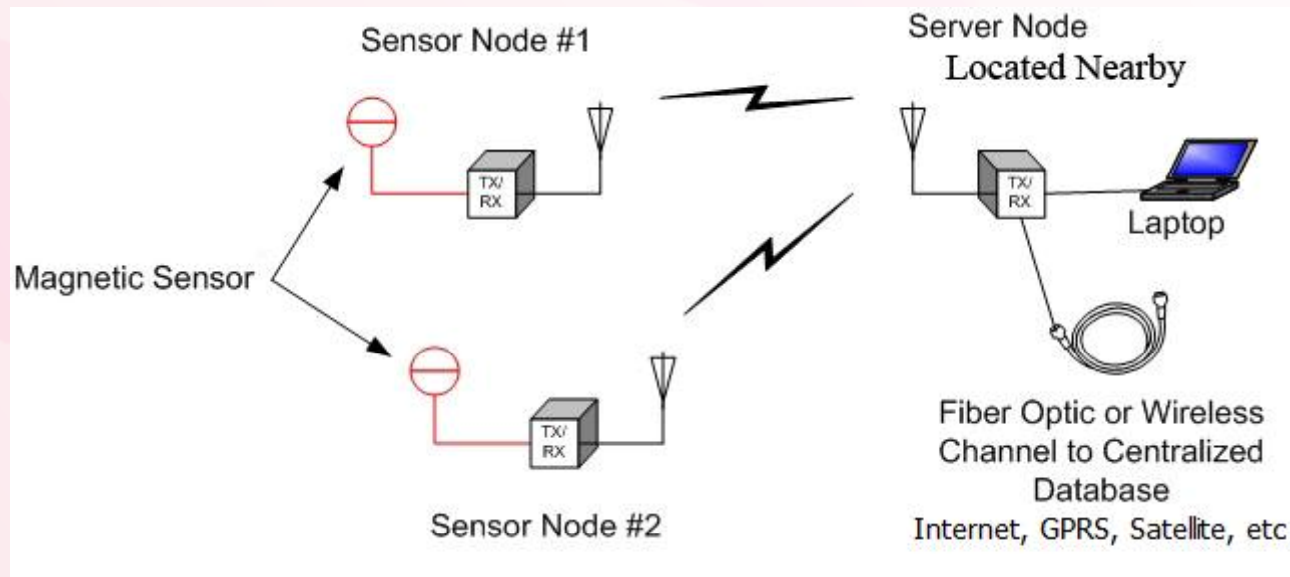
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Introduction

- **We propose a development of a vehicle monitoring system using wireless sensor networks. We employ wireless sensor network to automatically collect traffic information such as vehicle counts, average speed, and occupancy time.**

Wireless Sensor Network Architecture



Sensor Node and Server Node Component



Magnetic Sensor Node Components



Magnetic Server Node Components

Processor

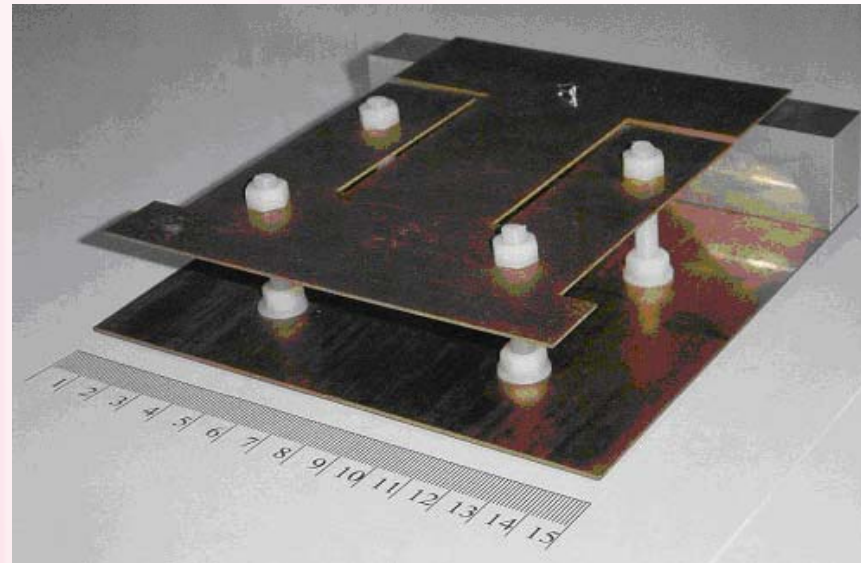
- Processor is responsible for sampling signal from magneto-resistive sensors.
- At a lower vehicle speed, more number of samples can be obtained and thus result in higher accuracy when classification is involved
- The processor also analyzes the signal for useful information such as vehicle count, speed, occupancy time, and classification

Magneto-resistive Sensor

- Magneto-resistive sensor is a sensor whose electrical resistance is changed according to imposing magnetic field.

RF Transceiver and Antennas

- Our RF frequency is 433



Communications Protocols

- Polling Protocol
- Modified Slotted Aloha

Polling Protocol

- Polling protocol is a simple MAC protocol that fits networks in which most sensor nodes send data to the server node all the time.
- In this polling protocol, the server node will periodically transmit polling packets that contain sensor node's ID that is allowed to transmit.

Modified Slotted Aloha

- Allows sensor nodes to transmit at any fixed intervals (time slots).
- The server node synchronizes with each sensor node by sending a polling packet at the beginning of each time slot.

Frame Format

- Frame Format between sensor node and server node
- Frame Format between server node and PC (data server)

Frame Format between sensor node and server node

Header							Data	Tail
Preamble	Sync Byte	Destination	Origin	Length	flag	CRC8	<i>Data</i>	CRC16
AAh	1 byte (5Ah)	1 byte	1 byte	1 bytes (Data)	1 byte	1 byte	Variable length	2 byte

Data Field Format

Data Field										
ID 2 bytes		Flag 1 byte	Toggle 1 byte	Inf 1 byte	Inf 1 byte	Inf 1 byte	Inf 1 byte	Inf 1 byte	Inf 1 byte	Description
NID	SID									
nn	ss	00h	0/1	P	x	x	x	x	x	Polling Packet, P=01h uses Aloha; P=02h uses Polling
nn	ss	01h	0/1	x-axis	x-axis	y-axis	y-axis	z-axis	z-axis	Data Packet, Raw Magnetic Data
nn	ss	02h	0/1	x	x	in	out	speed	x	Data Packet, Processed Magnetic Data (small)
nn	ss	03h	0/1	in	in	out	out	speed	speed	Data Packet, Processed Magnetic Data (large)
nn	ss	04h – 0Fh	0/1	ndef	ndef	ndef	ndef	ndef	ndef	Data Packets, Reserved for Magnetic Sensor
nn	ss	10h	0/1	data1	data1	data2	data2	data3	data3	Data Packet, Raw Optical Data
nn	ss	11h	0/1	x	x	in	out	speed	x	Data Packet, Processed Optical Data (small)
nn	ss	12h	0/1	in	in	out	out	speed	speed	Data Packet, Processed Optical Data (large)
nn	ss	13h – 1Fh	0/1	ndef	ndef	ndef	ndef	ndef	ndef	Data Packet, Reserved for Optical Sensor
nn	ss	20h – FFh	0/1	ndef	ndef	ndef	ndef	ndef	ndef	Reserved for Additional Sensor Types (ndef = not yet defined)

Frame format between sensor server and PC

Header					Data	Tail	
<i>Begin</i>	<i>Type</i>	<i>Origin</i>	<i>Destination</i>	<i>Length</i>	<i>Data Frame</i>	<i>CRC8</i>	<i>End</i>
02h	1 byte	1 byte	1 byte	2 bytes	Formats of data frame are varied upon the Type in Header	1 byte	2 bytes CR/ LF

Conclusions

- The wireless sensor network we design is extensible easily physically as we can add more number of nodes.
- The communications protocol is designed such that it allows an expansion of the network physically and functionally.

Thank you.