VEHICLE TO VEHICLE COMMUNICATION FOR COLLISION AWARENESS
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Abstract
This paper gives a protocol among vehicle for creating a collision warning. There is a lot of change in the modern world vehicles, and many new technologies are introduced into vehicles such as vehicle-to-vehicle (V2V) and Vehicle-to-roadside (V2R) communications such as DSRC. These are proving the road accidents can be reduced by alerting the drivers through warnings. VANET or Vehicular Ad-hoc Network is used to obtain the mentioned application.

Keywords: VANET, WSN, Road safety.

Introduction
Road Safety is one trouble that needs specific interest as there is one death pronounced every four minutes on the streets of India. India holds the maximum number of deaths due to road injuries. About 5 lakh street accidents have been accounted for in 2013 wherein more than 5 lakh individuals were dead. In the last couple of years’ communication between vehicles has attracted many researchers. The European Union a few research projects check out the capability of lowering road fatalities under the eSafety initiative (e.g. GST, PreVent). The identical is authentic in different countries just like the U.S.A or Japan. Car to car communication, frequently referred to as Vehicular Ad-hoc networks (VANETs), allows many new services for cars and creates several opportunities for safety improvements. Conversation between vehicles can e.g. be used to comprehend driver guide and active safety offerings like collision warning, up to date traffic and weather records or active navigation systems. But, except allowing new offering VANETs pose many challenges on generation, protocols, and security which urges the need of research in this area.

VANETs have comparable characteristics as mobile ad hoc networks, regularly in the form of multi-hop networks. Due to the excessive mobility of nodes community topology changes occur often. All nodes share the equal channel main to
congestion in very dense networks. The decentralized nature of VANETs leads to the want for new system concepts and facts dissemination protocols. Further, new tactics for records and conversation safety ought to be designed to healthy the precise community wishes and to guarantee reliable and honest offerings. Technologically, some of extra well-known questions need to be replied. Those encompass selection at the Wi-Fi communique preferred for use and message dissemination schemes able to changing messages in lots of extraordinary network eventualities. Not independent from this, issues like quality of service (QoS) and excessive pace actual-time communique will have to be tackled to enable on-the-fly collision caution or autonomously driving vehicles. The second one vital area of interest is the offerings and programs enabled via C2C communique. As may be shown later, the layout and provisioning of appealing automobile-tosurroundings or automobile-to-infrastructure offerings is vital for a hit market introduction of C2CC systems.

**Scenario and Use Cases**

Roads have usually been risky, and a lot of efforts were undertaken to enhance their safety. Vehicles, training, street symptoms have been improved during generations. Although, risks remain and with the upward thrust of computer and wireless technology, new answers are to be had to help the driver in unsafe situations and to lower street risks. We envision that during a near destiny, automobiles can be prepared with wireless gadgets, so that they are able to talk with each different. The primary application of this generation is to let motors change about their contemporary context. In element, the records exchanged can be of two types, (i) Periodic change of popularity messages the various motors in direct communication range and (ii) Protection messages prompted with the aid of an important event and dispensed in a geographical place. Within the equal time body of the VANET deployment, we count on that WSN technologies might have reached the important adulthood to be rolled out in a large scale at a cheap value. We foresee that WSN roadside
islands may be set up in particular risky locations to guide drivers with present day road and weather situation. Usually, WSN technologies help in which neither the automobile’s sensors nor the motive force can detect the threat, e.g. very localized avenue situation, animal crossing the street out of a woodland, etc. The roadside WSN islands significantly extend the sensing variety of a vehicles. Hence, either the driver or the vehicle itself could initiate appropriate reactions in line with the contemporary environmental conditions with the general goal to boom the driving force’s safety. The state of affairs of a combined WSN and VANET architecture aims at the provisioning of complementary services.

A. Collision Prevention

Whilst a vehicle passes by means of a sensor community, it retrieves fresh environmental statistics accumulated with the aid of the roadside sensors. Statistics can consist of diverse bodily portions, which include temperature, humidity and mild, and additionally hit upon transferring boundaries (together with animals); optionally, it is able to be processed in the WSN network, in an effort to OBU and doubtlessly exhibited to the driver. Therefore, Wi-Fi sensor nodes supplement different sensors set up in a vehicle (which includes radar). But, Wi-Fi sensor nodes are outside gadgets that during precept can measure road conditions records more appropriately than an on-board sensor. Further, the statistics of the wireless sensor node can also consist of a fixed of statistics overlaying a length of quantities accumulated over a time-span and make the records extra viable. Once a vehicle has processed the sensor data, it could interpret the information as a risky situation and trigger a protection warning message. For this message, the vehicle determines a geographical vicinity defined via a geometric shape and publicizes the message to its neighbor motors. The verbal exchange system of the cars guarantees that the information packets is reliably allotted to all vehicles positioned inside a place. As a result, cars that receive the records are warned approximately dangerous spots ahead of time and can take appropriate countermeasures.

B. Post-Accident Investigation

In this use case, sensor nodes constantly degree and keep the environmental information. Those records include the accrued portions (e.g. temperature) and additionally occasion facts, which include previously detected obstacles and cars. Storing these facts over a long time period can be of hobby for a forensic crew. In evaluation to the accident prevention provider, this type of liability provider could be constrained to a well distinct group of give up customers, e.g. coverage companies or the street patrol. These legal customers can retrieve the sensor information from the roadside WSN islands
from (nearly) any time within the beyond for forensics functions. Usual examples are retroactive discovery of coincidence reasons and evaluation of drivers’ behavior with admire to the road situations on the time of the coincidence. The two eventualities defined above pose various useful and performance-associated necessities for the statistics verbal exchange and garage. A fundamental assumption is that a communication system for automobile-to-roadside conversation will simplest be rolled out if the prices for the roadside system, installation, and renovation are minimum. This leads to a system architecture with extraordinarily low price self-sufficient sensor networks and without the deployment of committed roadside gadgets. Considering the fact that sensor nodes may additionally disappear over the years because of their limited strength talents, both conversation among sensors and facts storage need to be dispensed and redundantly organized. Likewise, sensor nodes’ facts transmission to drawing close vehicles and dissemination of facts for chronic storage require power-green verbal exchange protocols. The main requirements for the security is to make certain the reliability and the trustworthiness of the statistics being communicated from the WSN to the motors. In addition, because the records are saved for a relative lengthy length within the roadside WSN, they shall not be saved in simpletext. In flip, on the way to minimize charges, software program-based totally security solutions are desired over costly hardware components or tamper-resistant modules on sensor nodes.

System and Protocol

Architecture

Even as VANETs and WSNs have common characteristics, which include network selfbusiness enterprise, additionally they have crucial differences. VANET nodes are typically prepared with quite powerful computing devices. in addition, considering VANETs node are related to the power supply of an automobile or are located on the roadside, they commonly do no longer have constraints on strength intake. In comparison, sensor nodes have extremely small bodily dimensions and strong constraint inside the processing and power skills. VANET nodes also are tremendously cellular, resulting in common topology adjustments of the network, while sensor nodes are assumed to be static. The special characteristics of VANETs and WSN have caused the improvement of one of a kind technology component for radio, networking, middleware and packages.

Radio: - For VANETs, IEEE 802.eleven represents a value-efficient and extensively deployed answer so one can be implemented in OBUs and RSUs of future VANETs. Greater particularly, its version IEEE 802.11p is certain for
protection packages. The basic facts rate of IEEE 802.11p is three Mbps for a 10-MHz channel but better facts rates as much as 27 Mbps also are viable. In WSNs, IEEE 802.15.4 realizes a low expense, electricity-optimized radio generation for small, _250 kbps information rates.

Routing: - For routing in VANETs, Geocast helps Wi-Fi multi-hop conversation utilizing geographical positions for addressing and packet forwarding. Geocast permits scalable packet transport with common topology modifications and the green and reliable distribution of packets in geographical areas. A previous observe demonstrated that position-based totally routing which include Geocast notably outperformed topology-primarily based routing protocol in vehicular environments. The assumption in Geocast is that vehicles are geared up with a GPS device and are aware of their geographical positions. In assessment, WSNs are usually now not prepared with GPS to provide geographical positions and therefore observe other routing schemes which are higher applicable for static scenarios and optimized for strength performance. For instance, tiny LUNAR is a reactive, topology-based totally multi-hop routing scheme with minimum signaling overhead via applying a label-switching technique. Green coding label-switching is important for WSNs wherein bandwidth is scarce and valuable. Topology-based multi-hop routing scheme is also nicely appropriate for WSNs because sensor nodes are usually stationary. Middleware: - In each, VANETs and WSNs, a middleware collects, aggregates and shops accumulated information, but making use of extraordinary ideas. In VANETs, the middleware collects all records from one of a kind asset, inclusive of sensors interior of a vehicle (radar, digital camera, and so forth.) as well as with the aid of communiqué from other motors or the communication infrastructure, often combined with a digital map. In WSNs the middleware collects and shops the monitored data in a dispensed way. Because the sensor nodes may additionally disappear through the years, WSNs use techniques for a replicated, but space- and power green information storage. Furthermore, the monitored data need to be encrypted with a view to protect them from unauthorized entry.

Applications

VANETs desires to gain delivery of protection messages with low put off and high reliability. Then again, WSNs want to attain a dependable collection of precise environmental information. As sensor nodes are self-powered, the protocols have to be power-efficient, and the WSN must be capable of reorganize itself in case of node failures. From our aforementioned discussion, it's far tough to design a not unusual system architecture for each VANETs and WSNs. for
this reason, we recommend a hybrid gadget architecture that combines the high-quality of two worlds, VANETs and WSNs (Fig. 2): We use IEEE 802.15.4 as a low-cost and electricity-green radio generation in sensor nodes along the street side that talk over small distances and geographical areas. IEEE 802.11p is carried out inside the VANET – it's miles greater high priced however capable of ship information over medium distances and to distribute the facts in geographical areas through multi-hop communique. The principle benefit of the proposed architecture is the reality that it does no longer depend upon committed RSUs and saves the investment for set up and maintenance. The absence of devoted RSUs results in a few unique necessities for the device design, inclusive of the need for IEEE 802.15.4 radio technology in automobiles, disbursed and continual facts storage balanced over a couple of nodes, and a green protocol for strength-green injection of sensor facts into the VANET.

Within the proposed architecture, the sensor nodes inside the WSN screen environmental data, shop the information to passing automobiles through IEEE 802.14. The storage is encrypted and allotted over multiple nodes in a continual way. For communique some of the sensor nodes, the WSN is randomly divided into clusters, where every cluster is managed by way of a cluster head. The sensor nodes transmit facts to their cluster heads, which transmit the aggregated records to different cluster heads.

Data from the WSN are injected into the VANET by way of motors in the verbal exchange range of a sensor. The data transmission from a sensor to a car can either be periodic, solicited by way of the passing car, or each. Once the vehicle has obtained the sensor facts, it is able to distribute the facts to applicable in a geographical location with the aid of the Geocast protocol. Truly, the OBU of an automobile plays a crucial function in the structure since it acts as a gateway between the WSN and the VANET and makes a decision approximately injection and forwarding of applicable sensor information.

As an opportunity to the WSN with an allotted information garage, a RSU may act as a gateway between WSN and VANET. On this structure, the RSU collects all sensor facts, maintains the amassed, aggregated data in a local database, and injects the records into the VANET.

A vehicle’s OBU has a dual protocol stack. For communication in the VANET the OBU executes Geocast and IEEE 802.11p underneath the VANET middleware and alertness. it is well worth noting that a vehicle does now not want to enforce full tinyLUNAR, but the minimal functionality required to get right of entry to the WSN.
Prototype

Implementation

A. Setup: For the VANET node, the hardware NEC LinkBird-MX, an embedded device especially designed for automobile. For the wireless sensor network, we tested the system on commercially to be had TelosB structures. (Tab. I) offers an overview of the hardware of the testbed.

<table>
<thead>
<tr>
<th>Physical size</th>
<th>VANET node (NEC LinkBird-MX)</th>
<th>WSN node (Crossbow TelosB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor</td>
<td>153mm x 118 x 43mm</td>
<td>65 x 31 x 66 mm</td>
</tr>
<tr>
<td>Memory</td>
<td>64 bits MIPS@266 MHz</td>
<td>16 bits MCU @ 8 MHz</td>
</tr>
<tr>
<td>Memory</td>
<td>512 MB+16 MB program flash and 128 MB RAM</td>
<td>10 kB RAM, 48 MB program flash and 1MB for data logging</td>
</tr>
<tr>
<td>Power supply</td>
<td>5.4-22 VDC@400 mA max.</td>
<td>3 VDC@25 mA (active, sending) 6 µA (sleep)</td>
</tr>
<tr>
<td>Network interfaces</td>
<td>Fast Ethernet, IEEE 802.11p draft 3.0, IEEE 802.15.4 (only RSU)</td>
<td>IEEE 802.15.4</td>
</tr>
<tr>
<td>Connectors</td>
<td>UART (GPS, CAN), USB, MOST, VICS</td>
<td>UART, I2C, SPI</td>
</tr>
<tr>
<td>Antenna</td>
<td>External, Omni-directional, diversity</td>
<td>Nearly Omnidirectional(onboard) or directional (external)</td>
</tr>
<tr>
<td>Operating system</td>
<td>Linux 2.6</td>
<td>TinyOS</td>
</tr>
<tr>
<td>On-board sensors</td>
<td>None</td>
<td>Temperature, humidity, light.</td>
</tr>
</tbody>
</table>

| TABLE I | EXPERIMENTAL PROTOTYPE PLATFORMS FOR VANET AND WSN NODES |

The protocol stack of the vehicular conversation device is applied in C for the Linux OS, which leads to high performance and proper portability to embedded structures.
B. Indoor setup: The goal of the indoor assessments was to have a look at the functionality of every vehicle within the Geobroadcast variety to get hold of warning indicators initiated by way of the WSN. Three VANET nodes run an application that displays threat warnings to drivers through a visible HMI. Each VANET nodes run Geocast as part of the verbal exchange protocol stack. The positions of the motors are mocked by way of a 4th control laptop, which feeds the VANET nodes with function data and permits to reset, pause or start the test at whenever. Because of the proximity of the equipment, packet dropping is likewise emulated based on the distance among communique nodes. In the test, one of the VANET nodes is connected through IEEE 802.15.4 to a sensor observe that acts as a gateway to the sensor network. If this node is inside the area of the sensor network, it's going to receive sensor statistics, and ahead to other VANET nodes close by the usage of Geobroadcast.

C. Road setup: In the street setup, we've got deployed the WSN to cowl a place of approximately 900m (sq.) near to an avenue. The sensor nodes which could probably can communicate with cars are placed on poles status approximately 45 cm above ground. Nodes lying at the floor be afflicted by poorer connectivity due to a better degree of floor mirrored image and scattering. Within the take a look at, a car –ready with an on-board unit and an 802.15.4 interface – is riding towards the WSN with a Line-of-Sight (LoS) communication route. All through the check, the automobile periodically sends requests to retrieve WSN statistics. When the vehicle’s OBU receives records from the WSN, the caution is graphically proven to the driver through screen and HMI collectively with the measured distance between the automobile and the WSN. For the demonstration of the accident prevention carrier the vehicle must be driven in direction of the roadside WSN with varying velocities as much as 70 km/h. higher velocities could not be controlled thoroughly on our check spot because of the restrained road period. We measured approximately the distance at which the vehicle obtained the safety data from the WSN for the first time, which would determine the time left for a motive force to react to the incoming risk. The car sent a message to the roadside WSN every 200ms. An aggregator node receiving this kind of message replied with the aid of sending the actual aggregated cost in their cluster.

D. Post-accident investigation:

As coincidence Investigator Node (AIN) (see Fig. 3(a)) a widespread pc with a tinyPEDS consumer to retrieve beyond facts from the WSN can be used. In our putting, sensor nodes had the capability to store information for 50 days, which seems to be enough for an average put up-twist of fate investigation.
Conclusion

Vehicle-to-vehicle communication is an exciting and challenging new subject in conversation community studies. Even as many creative and powerful new solutions have already been proposed, nevertheless many open troubles exist. In addition to technical breakthroughs, the segment of market advent is important for the achievement of this new era. VANETs will simplest become a business and technological achievement so long as its offerings and skills are of high value to capacity users at some point of all phases of the creation segment. For this reason, services and technology ought to be adaptable to the distinct ranges of market penetration. exceptional of provider (especially regarding latency) and security for VANET structures are critical aspects of vehicle-to-car verbal exchange that want to be included to make certain the success of this promising era.

References

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