Research of Intelligent Vehicle Internet of Things based on anti-worm Model

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Abstract-Intelligent transport system that based on Internet of Vehicles is regarded as effective measure to guarantee the safety of highway transport. Anti-worm model in vehicular IOT is constructed based on divide-and-conquer with velocity and the drive velocity of vehicle node as the conversion condition between active and passive anti-worms in hybrid anti-worms. Implement this model on the design of Internet of Vehicles terminal, the simulation results show that this model can make the performance of network improved in highway environment regardless of complex road conditions domain and provides a theoretical basis for programming real-time detection strategy and preventing worm destructive epidemics in vehicular Internet of things.

Keywords-Internet of things; vehicular networks; network security; worm model;
Intelligent terminal

1. Introduction

As one of the application of the Internet of Things in Intelligent Transport System, Vehicular Internet of Things (VIOT) is paid more and more attention .Internet Transport System that based on Internet of Vehicles is regarded as effective measures to guarantee safety of highway transport. Communication can be built between vehicles nodes, as well as between nodes and base stations. Through Ad-Hoc, vehicles nodes beyond the range of signal can communicate each other.

This paper constructs a new model combing with the Space motion characteristics and wireless communication channel environment, and implements the simulation of vehicular IOT anti-worm. The model can not only better contain the vehicular IOT worm propagation, but also better hold down the network resources spending in anti-worm.

2 model construction

2.1 model analysis

This paper construct Vehicular Internet of Things Worm Propagation Model (VIOTWPM) considering the Intelligent Drive Model (IDM).This model preferably shows the influence over worm propagation in vehicular Internet of Things by these components, and factually simulates the worm propagation in vehicular Internet of thins, and provides a theoretical basis for programming real-time detection strategy and preventing worm destructive epidemics in vehicular Internet of things. Fig1 shows the worm propagation dynamics in urban road environment vehicular Internet of things, it can be divided into two categories by the vehicles nodes velocity.

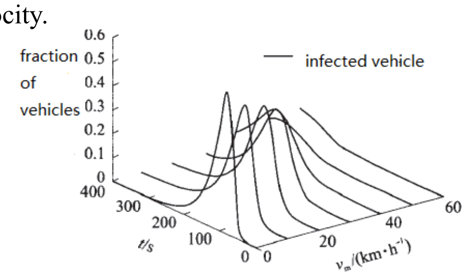

Fig 1 velocity VIOTWPM worm propagation dynamic

A new anti-worm model in vehicular IOT is constructed based on divided-and-conquer with velocity for different vehicle node velocity represents different road congestion environment and the worm propagation discipline In VIOT. The vehicle node has four states: susceptible, infected, benign infected, immunity.

Vehicle node is in state of susceptible when it is not infected by worm; susceptible and infected vehicle nodes can be cured by the anti-worm, system vulnerabilities can be patched and worm can be remove and only anti-worm can be propagated and the node itself is immune to worm and the anti-worm, now it is in the state of benign infection. Infected vehicle nodes can patch the system vulnerabilities and remove the worms by upgrading program, so it cannot propagate worm and itself cannot be infected by any worm, now it is in the state of immune. Hybrid anti-worm model is constructed and the Fig 2 shows the relationship of the four states.

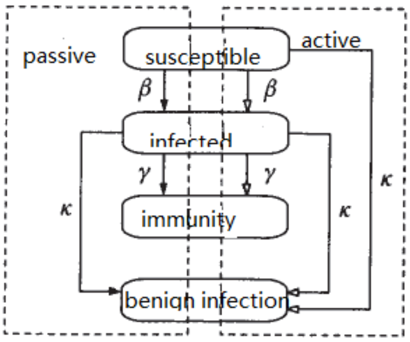

Fig2 status switching of passive anti-worm and the active anti-worm

β defines as the infection probability of vehicle nodes in susceptible state, γ defines as the probability in infected state which can be removed the worm and become the immune vehicle node, k defines as the probability which can infect the other vehicle nodes in susceptible and immunity state. Suppose at the T, the number of susceptible vehicle nodes is S(t),the number of infected is I(t),the number of immune is R(t),benign infected is B(t),the model of passive and active anti-worm is :

$$\begin{cases} \frac{dS(t)}{dt} = -\beta S(t)I(t) \\ \frac{dI(t)}{dt} = \beta S(t)I(t) - \gamma I(t) - \kappa I(t) \\ \frac{dR(t)}{dt} = \gamma I(t) \qquad \text{(passive)} \\ \frac{dB(t)}{dt} = \kappa I(t) \end{cases} \qquad (1)$$

$$\begin{cases} \frac{dS(t)}{dt} = -\beta S(t)I(t) - \kappa S(t)B(t) \\ \frac{dI(t)}{dt} = \beta S(t)I(t) - \gamma I(t) - \kappa I(t) \\ \frac{dR(t)}{dt} = \gamma I(t) \qquad \text{(active)} \\ \frac{dB(t)}{dt} = \kappa S(t)B(t) + \kappa I(t) \end{cases}$$

(2)

The drive velocity Vc of vehicle node is be treated as the conversion condition between active and passive anti-worms in hybrid anti-worms. The threshold is set as Vc ,when the node velocity is below or equal to it ,it is be treated as passive anti-worm, on the other hand, is active anti-worm. In the SIR model, the vehicle node is restricted in some specific area, in fact, in real-time urban road environment the vehicle nodes is varied ,at the same time there are many vehicle nodes ride in/off . b is set as the probability of the entry or exit at regular interval, the new arrival nodes is in the state of susceptible. At the same time the probability of the left nodes is set as b'. Usually at regular interval the arrival or the left vehicle nodes is approximately conservation. New anti-worm model in Vehicular Internet of Things based on Divide-and conquer with velocity is constructed as follow:

2.2 simulation analysis

Due to the anti-worm propagation in vehicular Internet of Things based on Divided-and-conquer with velocity, parameter is selected in this paper is shown as follow :

In order to represent the general characteristic of the road environment, the time interval is selected from 15 o'clock to 15:30 o'clock, the 1000 vehicle nodes are random selected .velocity parameter are gathered and simulation of the new anti-worm model in vehicular Internet of Things based on Divide-and –conquer with velocity is implemented.10 vehicle nodes are infected by the worm randomly ,another 1 vehicle node is infected anti-worm, every vehicle node implements the simulation at least 50 times. Different anti effect and the network resource spending as to the different V_c is shown as follow.

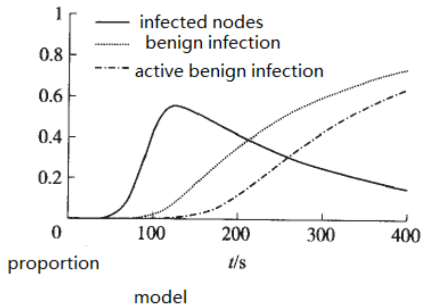

Fig3 switching time worm anti effect and the network resource spending

worm propagation dynamically changes according to the velocity of Urban road environment vehicular network nodes. Velocity parameter is gathered to simulate the worm infection. It is important to find the switch time of passive hybrid anti-worm and the active anti-worm.at the beginning 10 vehicle nodes are infected by the worm randomly, and another one vehicle nodes is infected by the anti-worm.

Contrast to the simulation and the conclusion can be drawn that when V_c =30km/h, the max proportion of infected vehicle nodes is smaller, and the infection duration time lasts shorter, the proportion of benign infection of vehicle nodes is smaller, and the network resource spending caused by the anti-worm is reduced. Characteristics are shown as follow:

Conclusion can be drawn from analysis of the new anti-worm model in vehicular Internet of Things based on Divide-and-conquer with velocity. In the simulation the sampling interval is 10km/h, the switch velocity of passive and the active anti-worm state is 30km/h, the model can not only better contain the vehicular IOT worm propagation, but also better hold down the network resource spending in anti-worm.

3 design of intelligent vehicle terminal

There are two types to build the inter-vehicle wireless communication: Road to vehicle (R2V) and Inter vehicles communication (IVC). R2V is depend two much on infrastructure construction whose fault will block the communication between vehicles and caused the system fail.

IVC communication is shown as follow, in this communication system, vehicles can directly communicate each other which is based on the ad-hoc network technology .IVC system can adapt to urban road environment even when the infrastructure construction is destroyed. The IVC communication system is selected to design the intelligent vehicle terminal.

3.1 internet of vehicles intelligent terminal hardware design

In this system, the terminal is designed by the following module: ad-hoc module.GPS vehicle locating module, GPRS transmission module, LCD display module and embedded processing module. Module are shown as follow:

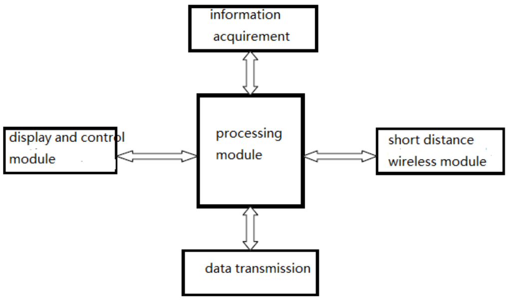

Fig4 intelligent vehicle terminal block diagram

Processing module is responsible for scheduling tasks and analysis of information which is the core components of the whole information inter-change.

Short-distance wireless module is important to ad-hoc network which connect different types of vehicle terminals and is responsible for communication of terminals.

Information acquirement's task is to get information and can be designed as general interface in order to suit different types of communication interface.

Data transmission module is the communication channel which is connect intelligent vehicle terminal with the transport system control panel.

Display and control module provide user interface for the convenient of the operate

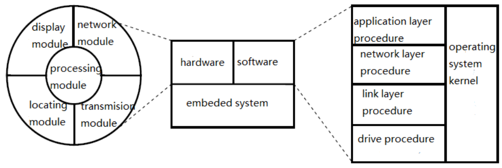

Fig5 vehicle terminal block diagram

Embedded system design is divided two part: hardware and software. hardware is involved in the selection of embedded processor and the wireless communication module and the display module.

Software is involved in the selection of embedded operation system kernel and the hierarchical division of the application. In the end the uC/OS-II is chosen as the operating system. The circuit diagram is shown as follow:

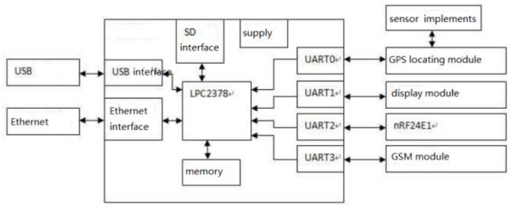

Fig6 system hardware block diagram

System is based on hardware and software .hardware design is focused on LPC2378 processor, including power supply circuit, reset circuit ,clock circuit ,JTAG interface circuit ,SPI interface Flash circuit, Ethernet PHY circuit, and Peripheral modules circuit. Software design has two aspects. Firstly, embedded real-time operating system uC/OSII is transplanted to LPC2378,and a software design platform is set up. Secondly, multi-tasking design is finished, including Ad Hoc network design, GPS locating module, GPRS Transmission module, LCD display and control module, and LPC 2378 module.

A new intelligent vehicle terminal system, which is based on ad hoc is proposed. On the basis of vehicular ad hoc network of highway environment, the system has some perception nodes, such as GPS location, temperature. Communication link with outside will be established through GPRS, and the commands are received. Meanwhile, a friendly user interface is designed.

Implement this model on the design of Internet of Vehicles terminal, the simulation results show that this model can make the performance of network improved in highway environment regardless of complex road conditions domain and provides a theoretical basis for programming real-time detection strategy and preventing worm destructive epidemics in vehicular Internet of things.

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References

[1] Jacquet P, Muhlethaler P, “Optimized Link State Routing Protocol For Ad Hoc Networks”. IEEE International Digital Object Identifier, 2001
[2] New anti-worm model in vehicular internet of things based on divide-and-conquer with velocity, Journal of Nanjing university of science and technology,2012,vol36
[3] Construction and simulation of worm propagation model in vehicular Internet of Things, computer science , march 2012,vol 39
[4] A Design of Intelligent Terminal in Internet of Vehicles and Research of its Routing Algorithm,2012
[5] Research of Key Technologies for Intervehicle communication based on Ad Hoc,2012
[6] A.A.B. Ariffin, N.H.A. Aziz, K.A. Othman, “Implementation of GPS for location tracking”