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Fault Detection and Diagnosis of CAN Bus for Modern Automobiles and Industries

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ABSTRACT: An Controller Area Network(CAN) bus is used in sending and receiving messages between devices in automobiles. During the transmission of messages through the nodes, there are possibilities of errors. To detect those errors an algorithm called Adaptive Fault Diagnosis algorithm for Controller Area Network(AFDCAN) is used to detects all faulty nodes on the CAN. The algorithm uses single-channel communication expanding the bus-based classic standard CAN protocol like single path communication. Faults at nodes can arise due to failures in the system, in the memory. Bugged node or faulty node doesn't send or receive packets to neighbour nodes and send wrong packets to neighbour nodes. CAN centrate uses an active hub to connect the CAN based nodes and prevents the propagation of errors from one port to others. The individual test results are exchanged among these processors and the fault-free processors accurately diagnoses the actuator fault. Test rounds continue until the last node in the system is tested. The last fault-free node sends the second result frame to the earlier fault-free node after all of the test rounds are completed. One node can be tested multiple times by another node, and tests are conducted asynchronously. The number of test rounds required for a hierarchical adaptive distributed system level diagnosis algorithm Hi-ADSD is less than that for adaptive DSD. Parameters are fault detection time, bus load, no of faults occurred.

KEYWORDS:AFDCAN(Adaptive Fault Diagnosis algorithm for Controller Area Network), CAN Bus, fault detection, fault Diagnosis, real-time systems.

I. INTRODUCTION

Network security has become more important to the personal computers. The internet itself allowed for many security threats to occur. The basic architecture of the internet, when modified a little can reduce the possible attacks like hacking and bugs that are sent across the network. Already knowing the attack methods, allows for the appropriate security to emerge. Many businesses protect themselves from the internet by means of firewalls and encryption mechanisms. The businesses create a network to remain connected to the internet but secured from possible attacks. Controller Area Network (CAN) bus used to find faults that is occurred in processing time. These faults need to be detected and diagnosed. Connection failures and node failures may lead to CAN network failure. Faults at nodes can arise due to failures in the controller, in the storage device, or in the input–output peripherals. An algorithm for CAN that detects all faulty nodes on can adaptive fault -diagnosis algorithm for CAN bus is been proposed. It allows new node entry and re-entry of repairing faulty nodes during a diagnostic cycle. The robustness of CAN may be attributed in part to its abundant error-checking procedures.

The main objective of this paper is to detect fault nodes, to reduce energy consumption, to obtain single channel communication in CAN. To detect the faults that are happening in the communication systems of CAN bus, detecting them and diagnosing them. Here, instead of removing the faulty parts a new reliable part is replaced for the faulty parts. The performance of the CAN bus through its throughput is shown in the graphical form. The graph represents the performance of the CAN bus after replacing the faulty nodes with the reliable nodes. By detecting and checking the frequency match of the nodes some time is consumed and as the bus load increases the throughput is represented. As the number of nodes increases the number of packets that is lost is represented in graph.

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II. RELATED WORK

CAN is a single-channel protocol [9]. It does not support redundant bus for communication among different nodes in the network [10]. Principle Component Analysis(PCA) and Independent Component Analysis (ICA) are used together to detect the faults in operating parameter identifiers which are collected through various sensors and diagnostic routines situated in the electronic control units (ECUs) [3]. A number of algorithms have been suggested in the area of fault diagnosis in distributed networks. Table 1 shows the comparison of some of these algorithms

Table 1 Comparision of Related Algorithm

Parameters	**Distributed Diagnosis Algorithm**	**Optimal Algorithm**	**Adaptive distributed system level algorithm**	**Adaptive fault diagnosis algorithm for CAN**
Algorithmic Approach	Parallel	Parallel	Parallel	Sequential
Main Features	New node entry. Link Failure detection	Many initiators in the sub tree	Multicast reporting. No restrictions on no of faulty nodes	Easy node entry, Reentry of repaired nodes, Less memory, High fault tolerance
Limitations	Increased traffic on the network due to diagnostic messages	Packet size increases	New node entry not supported	Link failure detection is very difficult. More time required for the diagnostic cycle.
Implemented on	Ethernet-based distributed computer systems	Ethernet-based distributed computer systems	Ethernet-based distributed computer systems	Distributed embedded systems
Result Obtained at nodes	Sequentially	Sequentially	Sequentially	Parallel

The adaptive algorithm does not use a fixed testing scheme but adapts to the current fault situation in the system, and the nodes are tested accordingly. In distributed computer systems, diagnostic tests are carried out by different nodes simultaneously and hence are termed as parallel. A fault detection method using parallel diagnostic tests would have been stressful to the distributed embedded systems which use bus topology.

III. FAULT DETECTION MECHANISMS

The CAN protocol uses the following error detection mechanisms:

1. Monitoring: The transmitter of a bit compares the signal sent with the signal seen on the bus line (transmission channel). Except for the arbitration phase during the transmission of the identifier of a message and in the ACK slot, a transmitter starts sending an error frame if the signal on the bus line is different from the signal sent. In this way bit errors affecting all stations on the bus cannot lead to non-detectable errors because they will be detected by the transmitter of the frame.
2. Cyclic Redundancy Check (CRC): The 15 CRC bits are computed from every bit from SOF to the last data bit. The BCH code used for generating the CRC leads to a hamming distance of six, including a parity check, in the unstuffed bit sequence.
3. Message Frame Check: The SOF, RTR, IDE, DLC, delimiter and EOF fields must be consistent with the CAN specification. If a fixed format field in a received frame (except for the last EOF bit) does not conform to the standard, the receiver sends an error frame and does not accept the received frame.
4. Bit Stuffing: Any violation of the stuff rule between SOF and CRC is regarded as an error.

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5. Acknowledgement: The transmitter of a data or remote frame treats a missing acknowledgement as an error and destroys the EOF field by sending an error frame.
6. Error Signaling: Each station that detects an error starts sending an error frame, so that other stations are notified of this condition by seeing a violation of the stuff rule or the fixed format delimiter or EOF fields. Note that due to the Bit Stuffing mechanism all stations answer a received error frame with error frames of their own.

IV.EXPERIMENTAL SETUP

1)Diagnosis And Fault-Tolerant Control

Control systems appear in many products that are used in everyday life such control systems can be found in house hold appliances ranging from mobile phones to satellites. But they can also be found in cars, ships, and aircraft. When a fault occurs the control system performs its operation & prevents damage of the system.

2)Fault Detection

For error free communication fault detection is necessary. It monitors the system behavior and identifies the fault, its type and its location. When an unpredicted change in the planned property of the system might result in different result and this is called as fault.

3)Error Capabilities

The CAN stipulation includes a Cyclic Redundancy Code to check errors on each frame's contents. Frames with errors are do not agree with all nodes, and an error frame can transmit error to the network system. The global and local faults are separated by the controller, and if too many errors are detected, individual nodes can be stopped from transmitting errors or make it disconnect itself from the network thoroughly.

4)Modules

1.Nodes deployed and create source and destination node
2. Fault diagnosis in single channel communication
3. Rectifying faults in CAN

4.1)Nodes deployed and create source and destination node Nodes are deployed in the network with the help of NS2.

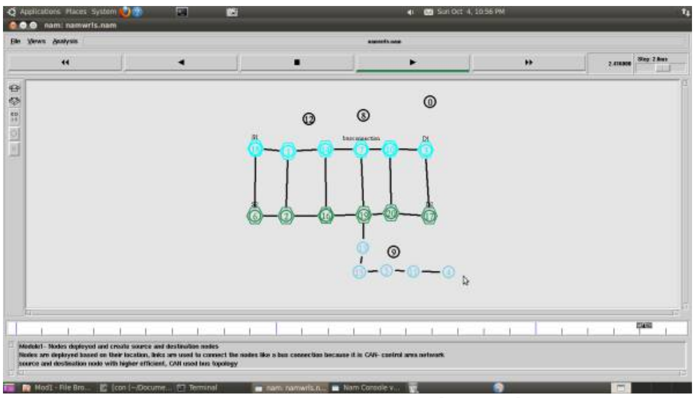

Fig. 1 Source & Destination node created

4.2)Fault diagnosis in single channel communication Source node want to send packet to neighbor node connected in bus.

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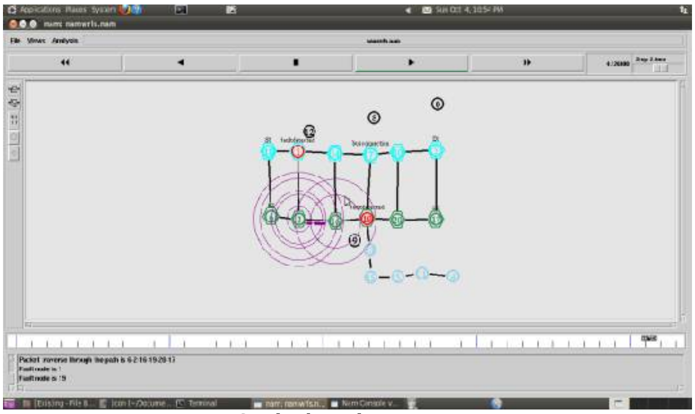

Fig.2 Single channel communication

4.3)Rectifying faults in CAN

checking newly connected nodes *6)CREATE NETWORK TOPOLOGY (PHYSICAL LAYER)* The Physical Layer is the first and the lowest layer in the OSI model of computer networking.

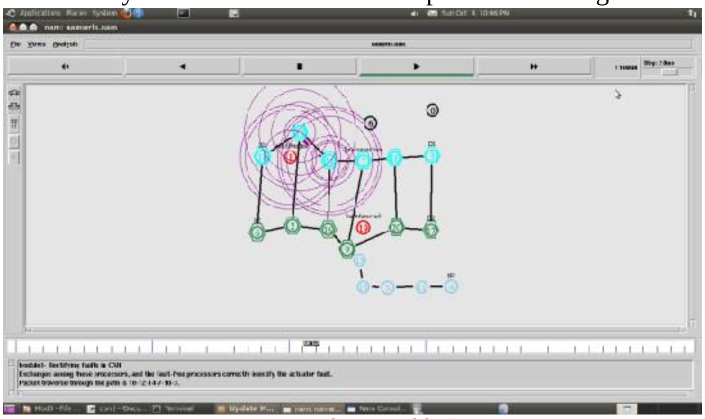

Fig.3 Rectification of faults

V. RESULT AND PERFORMANCE ANALYSIS

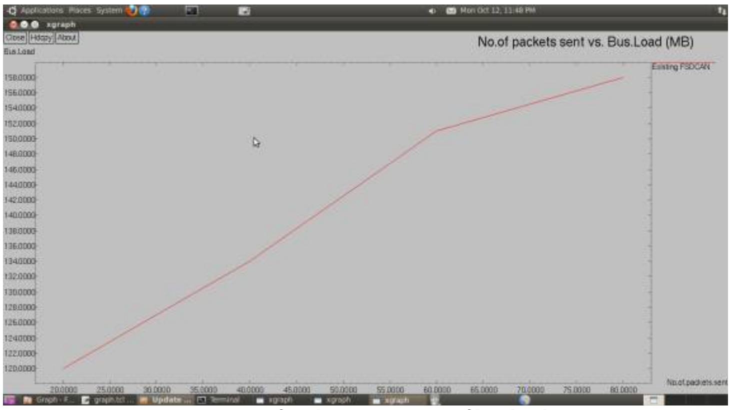

Fig.4 no. of packets sent vs no. of bus load

The Graph shows the amount of packets sent in according to the bus load.

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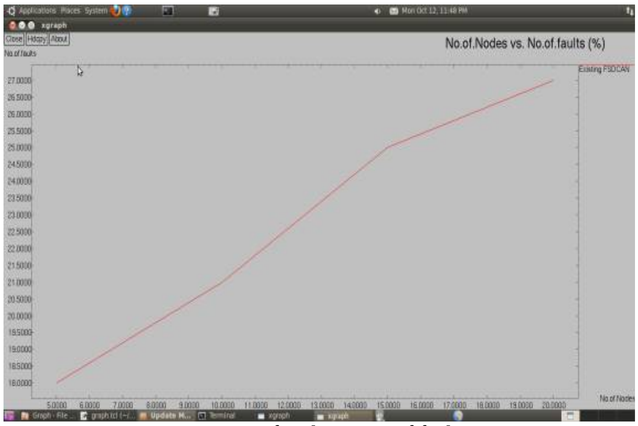

Fig. 5 no. of nodes vs no. of faults

The graph shows the number of packets lost for each number of nodes that is detected for fault.

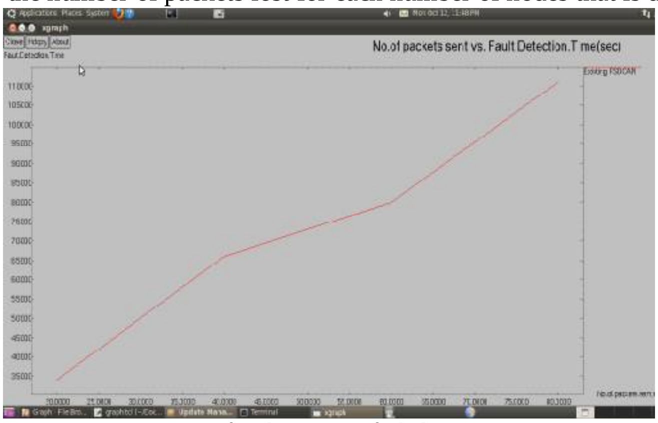

Fig. 6 no. of packets sent vs fault detection time

The time taken for the detection of fault during the number of packets sent is given in the graph.

Thus the graphs show the number of faults detected and the time taken to detect those faults. A disadvantage in the system is when the faulty nodes are replaced, to search for another node and again the packets are sent and verified weather the new node is a reliable node.

VI. CONCLUSION AND FUTURE WORK

The faults occurring in the CAN are detected by comparing each node with their IP address and their frequency. In this process the faulty nodes are identified and reliable node is searched and is attached and the process repeats again to reduce all the faulty nodes. This detection and correction process takes much time to send the packet at each iteration time is increased. Finally the correct packet is sent to its correct destination node. When the sent packets are not reached the destination then the fault is detected. We can improve the performance of the system by reducing the time taken to check the nodes and by detecting it previously.

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BIOGRAPHY

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