Agent Based Assistance System with Ubiquitous data mining for Road safety

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Abstract -**The number of accidents caused every year in India is disastrously high. 95% of these are attributed to drivers' errors. Risk assessment is at the core of the road safety problem. This paper presents an Advanced Driving Assistance System (ADAS), called ABASUR, that analyses situational driver behavior and proposes real-time countermeasures to minimize fatalities/casualties. The system is based on Ubiquitous Data Mining (UDM) concepts.**

It fuses and analyses different types of information from crash data and physiological sensors to diagnose driving risks in real time. The novelty of our approach consists of augmenting the diagnosis through UDM with associated countermeasures based on a context awareness mechanism. In other words, our system diagnoses and chooses a countermeasure by taking into account the contextual situation of the driver and the road conditions. The types of context we exploit include vehicle dynamics, drivers' physiological condition, driver's profile and environmental conditions.

The system, thus aims at proposing an innovative, intelligent system which aids the drivers take a proper decision to pre-decide their next move, hence reducing drastically the probability of many road accidents.

Keywords:ABASUR - Agent Based Assistance System with Ubiquitous data mining for Road safety, UDM – Ubiquitous Data Mining, ADAS – Advanced Driving Assistance System, LWC – Light Weight Clustering

I. INTRODUCTION

Reference Architecture

The following architecture (figure 1) which we came across during the survey of various papers has been used as a reference model to develop the system.

The components used in the system (Figure 2) are described below.

A. Sensors

- Environmental sensors- sense the present temperature and humidity of the surroundings
- Biometric sensors- identify the identity of a person uniquely. It may be any one of face detection techniques, fingerprint recognition, retina scan or any others.
- Speed sensor- detects the speed of the vehicle. It is integrated into the host vehicle itself.
- Count sensor - detects the number of vehicles passing a given point per unit time.
- Lane switching sensor- detects whether there is any change in lane of the vehicle on the road.

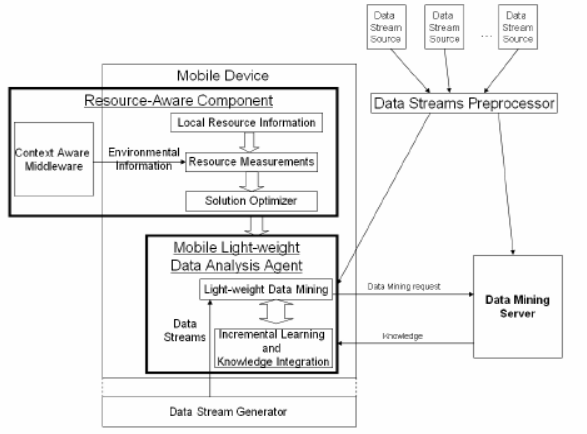

Figure 1. System reference Architecture

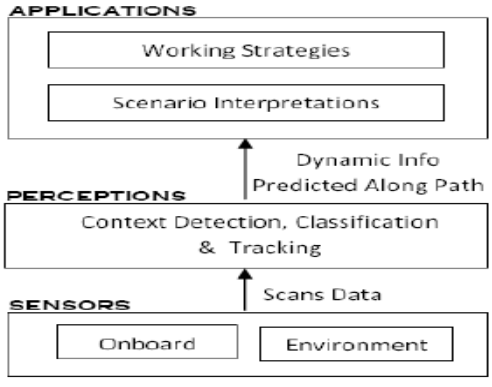

Figure 2. System 3-tier Architecture

B. Agent system

The agent system gathers data from several sensors that continuously detect environmental context conditions, speed, lane switch etc., and feed these to a UDM classificatory module. This agent system has the ability to cope with high

speed data streams and perform classification using the available predictive model in real-time.

C. Event Classification Model

It is a set of use cases describing the different contexts/hazardous situations which occur during the period of the vehicle on-road, and their respective counter measures.

D. Crash data

The crash data consists of the database of the all the drivers and the vehicles. The driver database consists of the driver attributes like driver id, age, experience etc. and the vehicle database consists of the vehicle attributes like reg. no., model, date of purchase etc.

E. Central server and human expert

Incase a new event is detected, the data regarding that event is sent to the central server. A human expert studies the new event and comes up with an appropriate countermeasure. Incase of failure of any of the components, the human expert at the central server detects it and takes corrective measures.

F. Data mining Algorithms

One of the main algorithms used is the LWC (Light Weight Clustering algorithm). It is a low overhead algorithm that takes advantage of any potential connectivity present in sensors to form clusters that can expose single collection points, therefore, optimizing data collection rates.

II. PROPOSED ARCHITECTURE

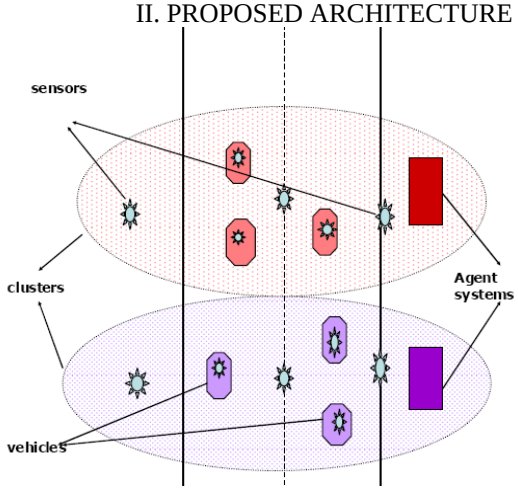

Figure 3. View of the two clusters

A. The LWC algorithm

The geographical area is divided into smaller regions called clusters. The clusters are formed on the basis of the range of the sensors and the computational capacity of the agent systems.

Each cluster comprises of one sensor each of the types environmental, lane switching and count, and as many sensors of the types biometric and speed as there are vehicles in the cluster. Each cluster has an agent system with sufficiently amount of resources necessary for computation of real time stream data (unlike mobile resource constrained devices).

The agent systems implement the light weight clustering algorithm. Also, the agents implement the UDM Classificatory module, which contains several cases of probable events which may occur and their respective countermeasures. All the sensors in the cluster detect their respective type of data and send it to their agent systems.

A special sensor is associated with each vehicle. This sensor is given a “sensor-ID”. The sensor-ID is used to identify a vehicle uniquely. The agent systems periodically broadcast packets called “discover” packets to know the vehicles presently existing in their cluster. This special sensor is used to receive the “discover” packet broadcasted by the agent. After receiving the packet, it sends an “Acknowledgement”, ACK packet along with the sensor-ID. Thus when the agent receives the ACK, it records the vehicle and makes it a part of its cluster. The agent systems feed the data emanating from the sensors as input to the classificatory module.

Here a particular situation is detected based on the sequence of events occurring in the cluster. The countermeasures associated with the particular situation to alleviate it are given out to all drivers who may be affected by the occurrence of the situation. The countermeasure is given out as an alert/ warning/ suggestion in the form of a voice signal or as a flash message on their PDA device.

The vehicle thus moves from one cluster to another repeating the above procedure.
Incase a new event is detected, the data regarding that event is sent to the central server. A human expert studies the new event and comes up with an appropriate countermeasure. This is added to the existing event classification model (classificatory module) as a new case. This new model is deployed to all the agent systems. It replaces the existing model. The event is detected the next time it occurs and the respective alert/warning is given out.

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