Artificial Passenger

A Seminar Report

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ABSTRACT

In the current times, people put their faith in resources to make life **smooth and luxurious.** An artificial passenger (AP) is designed to make **long solo journeys safer and more comfortable.** It is capable of **keeping the driver awake while driving during a long trip.** Studies have found that, 30 percent of road accidents occur annually due to the **drivers fatigue and drowsiness**.

An artificial passenger (AP) is a device that would be used in a motor vehicle to **make sure that the driver stays awake**. IBM has developed a prototype that holds a conversation with a driver, telling jokes and asking questions intended to determine whether the driver can respond alertly enough. Assuming the IBM approach, an artificial passenger would use a
microphone for the driver and a **speech generator** and the **vehicle's audio speakers** to converse with the driver.

The conversation would be based on a personalized profile of the driver. **A camera** could be used to evaluate the driver's **"facial state"** and a **voice analyzer** to evaluate whether the driver was becoming drowsy. If a driver seemed to display too much fatigue, the artificial passenger might be programmed to **open all the windows, sound a buzzer, increase background noise, music volume, or even spray the driver with ice water.**

CERTIFICATE

This is to certify that the work contained in this seminar report entitled " **Artificial Passenger** " submitted by **Aman Gaur (PRN No: 8021081708)** to the Department of Computer Applications, Faculty of Science, The Maharaja Sayajirao University of Baroda towards the partial requirement of **Master of Science** in **Information Technology** has been carried out by him under my supervision and that it has not been submitted elsewhere for the award of any degree.

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Last but not the least, I thank all others, and especially my classmates who in one way or another helped me in the successful completion of this work.

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INTRODUCTION

In the recent studies of road safety, it is found that human error was the sole cause in more than half of all accidents due the **inherent limitation** of human information processing.

With the rising popularity of Telematic services in vehicle (like **navigation, cellular telephone, internet access**) there is more information that drivers need to process and more devices that drivers need to control that might contribute to additional driving errors. This report is devoted to a discussion of **aspects of driver safety**.

LITERATURE REVIEW

The AP is an Artificial Intelligence – based companion that will reside in the software and chips embedded in the automobiles dashboard.

The conversational planner holds a profile of the driver / user . When activated , the AP uses the profile to cook up proactive questions such as "who was the first person you dated ? " via a speech generator and in-car speakers. (W.G.LEHNERT)

A microphone picks up your answers and breaks it down into separate words with speech-recognition software. A camera built into the dashboard also tracks your lip movements to improve the accuracy of the speech recognition.

A voice Analyzer then looks for signs of tiredness by checking whether the answers matches your profile.Slow responses and lack of intonation are signs of fatigue. If you reply quickly and clearly , the system judges you to be alert and tells the conversational planner to continue the line of questioning.

If the responses are slow or doesn't make sense , the voice analyzer assumes you are dropping off and acts to get your attention.
Driver could access its mobile calls , emails , or download files also by voice commands.

Overview

The AP is an **Artificial Intelligence–based companion** that will be resident in software and chips embedded in the automobile dashboard. The **heart of the system is a conversation planner** that holds a profile of you, including details of your interests and profession.

A **microphone** picks up your answer and breaks it down into separate words with **speech recognition software**. A **camera** built into the dashboard also tracks your lip movements to improve the accuracy of the speech recognition. **A voice analyser**, then looks for signs of tiredness by checking to see if the answer matches your profile. Slow responses and a lack of intonation are signs of fatigue.

This research suggests that we can **make predictions about various aspects of driver performance** based on what we glean from the movements of a driver's eyes and that a system can eventually be developed to capture this data and use it to **alert people** when their driving has become significantly impaired by **fatigue**.

The natural dialog car system analyzes a driver's answer and the contents of the answer together with his voice patterns to determine if he is alert while driving. The system warns the driver or changes the topic of conversation if the system determines that the driver is about to fall asleep. The system may also detect whether a driver is affected by alcohol or drugs.

Background Of The Invention

During the night times the driver could get sleepier which may cause accidents. So in order to overcome the sleepiness the driver could have taken one of the following or all the below precautions.

- Use of simulation drinks (e.g.: coffee and tea)
- Some tablets to prevent sleeping.
- Miniature system installed in driver's hat.

As these methods are some times inefficient and it may affect the health conditions of the driver. So in order to overcome the disadvantages of these methods *IBM* introduces a new sleep prevention technology device called as "*ARTIFICIAL PASSENGER*" which was developed by **Dimitry Kanevsky** and **Wlodek Zadrozny.** This software holds the conversation with driver to determine whether the driver can respond alertly enough.

The name *artificial passenger* was first suggested in new scientist magazine which was designed to make solo journey safer and more bearable. Early techniques for determining head-pose used devices that were fixed to the head of the subject to be tracked. For example, reflective devices were attached to the subjects head and using a light source to illuminate the reflectors, the reflector locations were determined. As such reflective devices are more easily tracked than the head itself, the problem of tracking head-pose was simplified greatly.

Virtual-reality headsets are another example of the subject wearing a device for the purpose of head-pose tracking. These devices typically rely on a directional antenna and radio frequency sources, or directional magnetic measurement to determine head-pose. Wearing a device of any sort is clearly a disadvantage, as the user's competence and acceptance to wearing the device which directly effects the reliability of the system.

Devices are generally intrusive and will affect a user's behaviour, preventing natural motion or operation. Structured light techniques that project patterns of light onto the face in order to determine headpose are also known. The light patterns are structured to facilitate the recovery of 3D information using simple image processing. However, the technique is prone to error in conditions of lighting variation and is therefore unsuitable for use under natural lighting conditions.

Why Such Systems?

According to the national survey in UK and USA, it is observed that driver fatigue annually causes

- 100,000 crashes
- 15000 deaths
- 71,000 injuries

Which cause annual cost of $12.5 billion.


(Car - Accident)

A majority of the off-road accidents observed were preceded by eye closures of one-half second to as long as 2 to 3 seconds. A normal human blink lasts 0.2 to 0.3 second.

Advantages of using this system:

- Artificial Passenger is broadly used to prevent accident.
- Artificial Passenger device is also used for entertainment such as it telling jokes and asking question .
- Artificial Passenger component establishes interface with other drivers very easily.
- Open and close the window of a car automatically and also answer a call for you.
- If the driver gets a heart attack or he is drunk it will send signals to vehicles nearby about this so driver there become alert.
- Provide a natural dialog car system that understands content of tapes, books and radio programs.

FUNCTIONS OF ARTIFICIAL PASSENGER

Voice control interface

According to Dimitri Kanevsky, a former IBM researcher, currently at Google, The Artificial Passenger was developed using the Conversational Interactivity for Telematics (CIT) speech system which counts on the driver's natural speech instead of the use of hands.
The CIT relies on a Natural Language Understanding (NLU) system that is difficult to develop because of the low-powered computer systems available inside cars. IBM suggests that this system be located on a server and accessed through the cars' wireless technologies. IBM also says they are working on a "quasi-NLU" that uses fewer resources from the CPU and can be used inside the car. The CIT system includes another system called the Dialog Manager (DM). The DM takes the load of the NLU system by interacting with the vehicle, the driver, and external systems such as weather systems, email, telephones and more.

The NLU system receives a voice command from the driver and looks through a file system to come up with an action to be performed and executes that action. The DM works with questions asked by the driver such as "How far is The Gallatin Field Airport from here?" The NLU system will still not be able to understand everything a driver says. Reasons for that are the different idioms and dialects of different regions. IBM is working on developing a system that recognizes where the driver is and acknowledge the regional diction used in that area.

Another system used within this technology is the Learning Transformation (LT) system which monitors the actions of the occupants of the car and of the cars around it, learns patterns within the driver's speech and store that data, and learns from such data to try to improve the performance of the technology as a whole.

Speech recognition

The speech recognition process relies on three steps. The **front-end filters** out any unwanted noise such as noise from the car, background music, or background passengers. It gets rid of all low energy and high variability signal being recognized. The **labeler** breaks apart the speech and searches in a data base to recognize what is being said. It starts broad by seeing what subject the driver is speaking of. Then goes into more details of what the driver is truly asking. The decoder next takes all this information and formulates a response to the driver. IBM states through much experimentation that the speech recognition is very accurate but the process has not fully been refined and still has kinks with in it.

The **main part** of the Artificial Passenger is the disruptive speech recognition. This technology keeps a conversation with the driver and analyses what the driver is saying and how he/she is saying it. It can recognize fluctuations in the driver's voice to determine if the driver is sleepy, upset, or in a good mood through different vibration patterns in the driver's speech. It also record the time it takes for a driver to respond in the conversation and from that determine if the driver is nodding off or being distracted by something.

(Speech Recogniser)

Driver drowsiness prevention

When the computer recognizes that the driver is dozing off, it sends a signal to interfere. The computer will step in by changing the radio, trying to play games with the driver, or by opening window to wake the driver up. The computer wants to improve their alertness by doing these. If it finds that the driver is nodding off over and over, the computer system is programmed to ask to call a nearby hotel and book a room or suggest the driver take a break.

The Artificial Passenger will try to read jokes, play games, ask questions or read interactive books to stimulate the driver. Drivers that show more drowsiness will be given content that is more stimulating than a driver who is not as drowsy.


(Steering wheel sensor)

Distributive user interface between cars

IBM recognizes that there are more dangers to a driver than him/herself. Artificial Passenger is proposed to work between cars by relaying information to one another. The information could include driving records to show if they have a history of being a bad driver or on-time analysis of all drivers to show which ones are becoming drowsy and can interfere through this information. It can also show if a driver is being distracted by games or wireless devices and interfere with all surrounding drivers.

FEATURES OF ARTIFICIAL PASSENGER

1. CONVERSATIONAL TELEMATICS:

IBM's Artificial Passenger is like having a butler in your car—someone who looks after you, takes care of your every need, is bent on providing service, and has enough intelligence to anticipate your needs. This voice-actuated telematics system helps you perform certain actions within your car hands-free: turn on the radio, switch stations, adjust HVAC, make a cell phone call, and more. It provides uniform access to devices and networked services in and outside your car. It reports car conditions and external hazards with minimal distraction. Plus, it helps you stay awake with some form of entertainment when it detects you're getting drowsy.

In time, the Artificial Passenger technology will go beyond simple command-and-control. Interactivity will be key. So will natural sounding dialog. For starters, it won't be repetitive ("Sorry your door is open, sorry your door is open . . ."). It will ask for corrections if it determines it misunderstood you. The amount of information it provides will be based on its "assessment of the driver's cognitive load" (i.e., the situation). It can learn your habits, such as how you adjust your seat. Parts of this technology are 12 to 18 months away from broad implementation.

2. IMPROVING SPEECH RECOGNITION:

You're driving at 70 mph, it's raining hard, a truck is passing, the car radio is blasting, and the A/C is on. Such noisy environments are a challenge to speech recognition systems, including the Artificial Passenger.

IBM's Audio Visual Speech Recognition (AVSR) cuts through the noise. It reads lips to augment speech recognition. Cameras focused on the driver's mouth do the lip reading; IBM's Embedded Via Voice does the speech recognition. In places with moderate noise, where conventional speech recognition has a 1% error rate, the error rate of AVSR is less than 1%. In places roughly ten times noisier, speech recognition has about a 2% error rate; AVSR's is still pretty good (1% error rate). When the ambient noise is just as loud as the driver talking, speech recognition loses about 10% of the words; AVSR, 3%. Not great, but certainly usable.

3. ANALYZING DATA:

The sensors and embedded controllers in today's cars collect a wealth of data. The next step is to have them "phone home," transmitting that wealth back to those who can use those data. Making sense of that detailed data is hardly a trivial matter, though —especially when divining transient problems or analyzing data about the vehicle's operation over time.IBM's Automated Analysis Initiative is a data management system for identifying failure trends and predicting specific vehicle failures before they happen.

The system comprises capturing, retrieving, storing, and analyzing vehicle data; exploring data to identify features and trends; developing and testing reusable analytics; and evaluating as well as deriving corrective measures. It involves several reasoning techniques, including filters, transformations, fuzzy logic, and clustering/mining. Since 1999, this sort of technology has helped Peugeot diagnose and repair 90% of its cars within four hours, and 80% of its cars within a day (versus days). An Internet-based diagnostics server reads the car data to determine the root cause of a problem or lead the technician through a series of tests. The server also takes a "snapshot" of the data and repair steps. Should the problem reappear, the system has the fix readily available.

4. SHARING DATA:

Collecting dynamic and event-driven data is one problem. Another is ensuring data security, integrity, and regulatory compliance while sharing that data. For instance, vehicle identifiers, locations, and diagnostics data from a fleet of vehicles can be used by a variety of interested, and sometimes competitive, parties. These data can be used to monitor the vehicles (something the fleet agency will definitely want to do, and so too may an automaker eager to analyse its vehicles' performance), to trigger emergency roadside assistance (third-party service provider), and to feed the local "traffic helicopter" report.

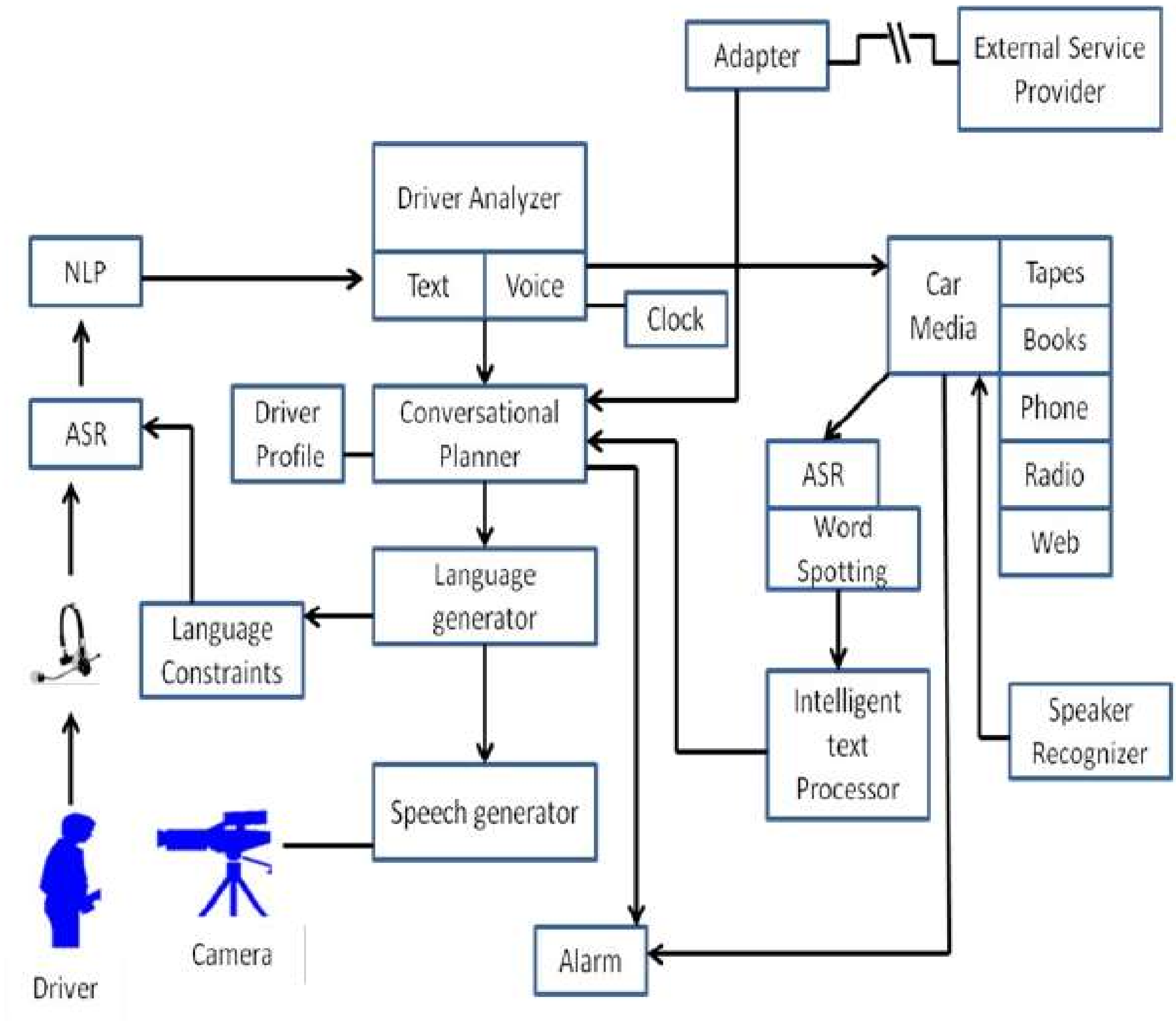
This IBM project is the basis of a "Pay As You Drive" program in the United Kingdom. By monitoring car model data and policy-holder driving habits (the ones that opt-in), an insurance company can establish fair premiums based on car model and the driver's safety record. The technology is also behind the "black boxes" readied for New York City's yellow taxis and limousines.

5. RETRIEVING DATA ON DEMAND:

“Plumbing”—the infrastructure stuff. In time, telematics will be another web service, using sophisticated back-end data processing of “live” and stored data from a variety of distributed, sometimes unconventional, external data sources, such as other cars, sensors, phone directories, e-coupon servers, even wireless PDAs. IBM calls this its “Resource Manager,” a software server for retrieving and delivering live data on demand.

This server will have to manage a broad range of data that frequently, constantly, and rapidly change. The server must give service providers the ability to declare what data they want, even without knowing exactly where those data reside. Moreover, the server must scale to encompass the increasing numbers of telematics enabled cars, the huge volumes of data collected, and all the data out on the Internet. A future application of this technology would provide you with a “shortest-time” routing based on road conditions changing because of weather and traffic, remote diagnostics of your car and cars on your route, destination requirements (your flight has been delayed), and nearby incentives (“e-coupons” for restaurants along your way).

Working Components



There are some of the components which supports for the working of the system:

- Automatic Speech Recognizer (ASR)
- Natural Language Processor (NLP)
- Driver analyser
- Conversational planner (CP)
- External service provider
- Microphone
- Camera

Automatic Speech Recognition (ASR):

There are two ASRs used in the system:

1) Speaker independent: It will decode the driver voice and the decoded voice signals will output to Natural Language Processor (NLP)
2) Operates with a voice car media, decodes tapes, audio books, telephone mails.

Decoding outputs of the ASR module is analyzed by Intelligent text processor and it will output data to conversational planner.

Natural Language Processor (NLP):

Processes the decoded signal of textual data from ASR module, identifies semantic and syntactic content of the decoded message , produces variants of responses and outputs this data to a text input of the driver analyser.

Driver analyser:

Receives the textual data and voice data from NLP and measures the time of response using a clock. This time responses, concludes about drivers alertness and it will output to the conversational planner. This analysis is both objective & subjective.

Conversational planner:

This is generally referred as the heart of the system and it instructs the language generator to produce the response. If the driver continues to be in a perfect condition, then conversational planner instructs the language generator to continue the conversation otherwise the language generator is instructed to change the conversation.

External Service Provider:

Linked to the dialog system by wireless network system as it is coupled with

- Car media, driver profile, conversational planner
- Driver analyzer module.

It controls interruption of a dialog between the driver and the car dashboard (for example, interrupting a conversation to deliver an urgent message about traffic conditions on an expected driver route).

Microphone:

It picks up the words and separate it using speech recognition software.

Camera:

A camera built into the dashboard used to track the lip movement of the driver to improve the accuracy of the speech recognition.

WORKING OF ARTIFICIAL PASSENGER

The AP is an artificial intelligence–based companion that will be resident in software and chips embedded in the automobile dashboard. The heart of the system is a **conversation planner** that holds a profile of you, including details of your interests and profession. When activated, the AP uses the profile to cook up provocative questions such as, “Who was the first person you dated?” via a **speech generator and in-car speakers**. A **microphone** picks up your answer and breaks it down into separate words with **speech-recognition software**. A **camera** built into the dashboard also **tracks your lip** movements to improve the accuracy of the speech recognition. A **voice analyser** then looks for signs of tiredness by checking to see if the answer matches your profile. Slow responses and a lack of intonation are signs of fatigue.

If you reply quickly and clearly, the system judges you to be alert and tells the conversation planner to continue the line of questioning. If your response is slow or doesn’t make sense, the voice analyser assumes you are dropping off and acts to get your attention.

The system, according to its inventors, does not go through a suite of rote questions demanding rote answers. Rather, it knows your tastes and will even, if you wish, make certain you never miss Paul Harvey again. This is from the patent application:

“An even further object of the present invention is to provide a natural dialog car system that understands content of tapes, books, and radio programs and extracts and reproduces appropriate phrases from those materials while it is talking with a driver. For example, a system can find out if someone is singing on a channel of a radio station. The system will state, “**And now you will hear a wonderful song!**” or detect that there is news and state, “**Do you know what happened now—hear the following—and play some news.**” The system also includes a recognition system to detect who is speaking over the radio and alert the driver if the person speaking is one the driver wishes to hear.”

Just because you can express the rules of grammar in software doesn't mean a driver is going to use them. The AP is ready for that possibility: "It provides for a natural dialog car system directed to human factor engineering —for example, people using different strategies to talk (for instance, short vs. elaborate responses). In this manner, the individual is guided to talk in a certain way so as to make the system work—e.g., "**Sorry, I didn't get it. Could you say it briefly?**" Here, the system defines a narrow topic of the user reply (answer or question) via an association of classes of relevant words via decision trees. The system builds a reply sentence asking what are most probable word sequences that could follow the user's reply."

Applications

First introduced in US Sensor/Software system detects and counteracts sleepiness behind the wheel. Seventies staples John Travolta and the Eagles made successful comebacks, and another is trying: That voice in the automobile dashboard that used to remind drivers to check the headlights and buckle up could return to new cars in just a few years—this time with jokes, a huge vocabulary, and a spray bottle.

Other Applications Include

- Artificial Passenger is broadly used to prevent accident.
- Artificial Passenger device is also used for entertainment such as asking questions.
- Artificial Passenger component establishes interface with other drivers very easily.
- Open and close the window of a car automatically and also answer a call for you.
- In any problem it alerts the vehicles near by, so the driver there can become alert.
- Opens and closes the doors and windows of the car automatically.

Conclusions

We suggested that such important issues related to a driver safety, such as controlling Telematics devices and drowsiness can be addressed by a special speech interface. This interface requires interactions with workload, dialog, event, privacy, situation and other modules. We showed that basic speech interactions can be done in a low-resource embedded processor and this allows a development of a useful local component of Safety Driver Manager.

The reduction of conventional speech processes to low – resources processing was done by reducing a signal processing and decoding load in such a way that it did not significantly affect decoding accuracy and by the development of quasi-NLU principles. We observed that an important application like Artificial Passenger can be sufficiently entertaining for a driver with relatively little dialog complexity requirements – playing simple voice games with a vocabulary containing a few words. Successful implementation of Safety Driver Manager would allow use of various services in cars (like reading e-mail, navigation, downloading music titles etc.) without compromising a driver safety.

Providing new services in a car environment is important to make the driver comfortable and it can be a significant source of revenues for Telematics. We expect that novel ideas in this paper regarding the use of speech and distributive user interfaces in Telematics will have a significant impact on driver safety and they will be the subject of intensive research and development in forthcoming years at IBM and other laboratories.

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