

ECE480

Pre-Proposal

Video and audio recording tool for car
infotainment and navigation system

Sponser: Bosch

Facilitator: Dr. Hayder Radha

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Introduction:

The idea behind this project has been developed at the Car Multimedia Division at Bosch, where many issues regarding testing and results accuracy arise. Running regular tests on new vehicle's entertainment systems can take place on the course of multiple months. Testing hours can range between a short ride to the gas station, or crossing a number of states.

When testing the GPS system in the recent Infotainment system under development, Bosch employees would run into events where the GPS audio output would differ from the actual road or city's information. These errors result from the GPS system, and can also be associated with the driver or other error. Inaccuracies also occur due to some of the employees engagement with multiple projects in the company, where they are bound to become occupied with many tasks that require other employees to take over and continue running the tests. Having a different employee pick up the research and testing from where ever the previous one stopped is a good solution to stay on the development track. However, since the incoming employee might have difficulties understanding the exact steps and procedures that took place in the previous tests, this can become an issue, thus impacting the final result.

Therefore, developing a system with video, audio, and navigation information recording ability at all occurring events while testing, can help debugging the system and identifying errors.

Background:

Bosch has been known for research and development in the field of audio entertainment systems from as early as 1932, and throughout the years they have managed to develop many modules. These modules have been incorporated with traffic and road information features.

The current Infotainment system, developed by Bosch, has won them the "Best-of-CES Award 2013 or Chevrolet My Link System ". This, particular, User Friendly system combines more than an audio, video and navigation systems. It links multiple features such as: entertainment, navigation, communication and operating functions. This system stands out from the other products in the market due to its options and features that can be expanded further by simply adding applications similarly to a smartphone. Also, it is an extremely user friendly system that uses natural human voice input without having to memorize particular commands, providing a safer "hands on wheels at all times" driving experience. (Bosch)

There are various entertainment systems that have been developed to test this award winning technology, however the only system that is currently available at Bosch Labs for in-car, on-road, quality testing, is a fairly expensive and manual set of video recording equipment.

Currently, a set of hardware called “Blue Pirate” is being used to house the data for in-car, on-road testing of their Infotainment system. The device can connect to very few cameras and its flagging features, to track any of the errors found during the road test, are completely manual. To specify, road tests must have, at least, two (2) members in the car, who are synchronously and manually setting flags, via a button to start and stop the system, in addition to, recording the data either written and/or via the device through an audio recording feature - which is also a manual operation. As the testing is done while on the road, this leaves a considerable amount of room for human error.

This current error-monitoring method also creates additional distraction for the driver from the road. Following the road test, video recorded data must be cut and edited by hand by one of the members of the team, to sort out essential and nonessential video clips, which can be tedious and time consuming.

Objectives and Design Specification:

Given the project description and specifications, the team understands the requirements and deliverables, and managed to brainstorm potential ideas that are compatible with Bosch’s requirements.

The system is required to operate four different cameras placed on different locations inside and outside the car. The first and second cameras will be placed to display the instrument cluster and the center stack display. Mounting these cameras with a recording feature will assist in documenting any GPS bugs or human error capable of disturbing the testing process. The third camera will be placed outside the car on the right side; focusing on street names. The last camera will be placed on top of the car; viewing the highway road signs. On the road, these cameras must be recording simultaneously on one display as the road test is taking place. Aside to the video display, the system must also contain a microphone to monitor, detect, and record audio-related errors. Also, it must include a GPS position tracker that records the vehicle's location corresponding to the four camera’s Video.

In addition, a storage device is required. An SD card or a USB drive can be used to save recorded information. Videos can be streamed in analog or digital; however it’s preferred to have all outputted data be compressed in a small file. Likewise, the system should operate on low power, approximately around 12V.

Regarding the microcontroller or microcomputers, the system should work on any type as long as it matches the specifications stated above. Also the team is free to choose the programming language.

Additional features can be added to the product, if the time and resources constraints allow. For instance, it would be convenient to display: storage capacity, time and date, event or trigger number and file names.

Conceptual Design Descriptions:

One of the specific details that the sponsor indicated, was to be able to operate the system without using a netbook, tablet or a laptop. It is preferable to be able to start and stop recording with a press of a button for the flagging of errors found during the monitoring process, and for the boot up and boot down process of the device.

The system must be user friendly in saving and reviewing the recorded information. In order to accomplish that, adding video numbering, triggering and flagging options can simplify the use. Saving the videos can be done in different processing order, the team could design the the system to take an image, save it and then compile it, or it can take multiple images instead. Recording the information can be in any processing order, however it must have PC based compatibility. As per sponsor's preference, using an SD card with a space larger than 32GB is important, to be able to save multiple videos of occurring events on longer duration tests.

Also, a display screen, along with all gadgets, must be assembled in a reasonably small size, where the screen's size is approximately 4-5 inches. The video quality can vary according to location. For the inner cameras, the image quality can be 480p. On the other hand, the outer cameras must have higher than 480p. The outer cameras are encountering more than one source of disturbance, in addition to, instability and vibration caused by the movement of the vehicle. After running multiple tests on the outer cameras within the upcoming week, the team will decide on the image quality for outer cameras. Additionally, a webcam will be able to capture audio in the car in order to help troubleshoot audio and voice GPS issues that arise.

Finally, the team managed to come up with an initial design of the **device output's display**:

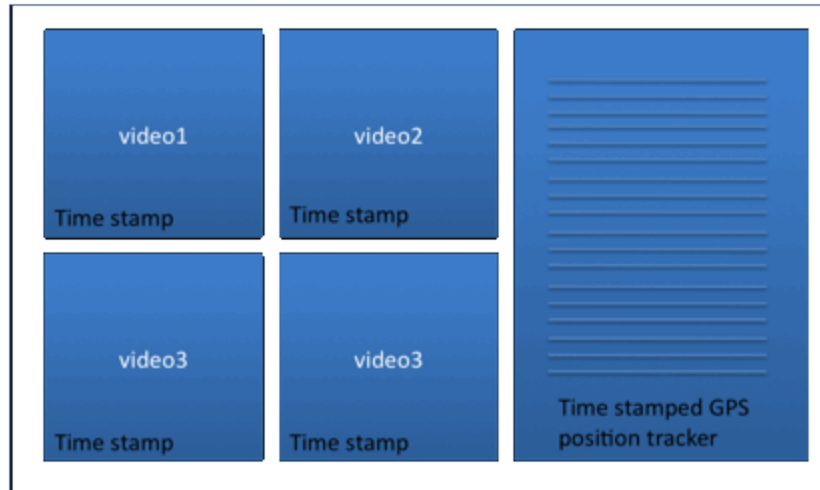


Figure1: output device display

Proposed design solutions:

Our proposed design solution can be separated into hardware and software designs

Hardware Architecture:

1. Asus Eee Box EB1033-B0060 Nettop Computer
<http://www.newegg.com/Product/Product.aspx?Item=N82E16883220297>
 - a. Intel Atom D2700 (2.13GHz, dual core)
 - b. DDR3 1600/1333 4GB
 - c. GeForce 610M
 - d. wifi 802.11 a/b/g/n and 10/100/1000Mbps LAN
 - e. 6 USB Ports Total (2 x USB 3.0 and 4 x USB 2.0)
 - f. 4 in 1 card reader
 - g. Microphone Jack
 - h. Low powered
 - i. No internal hard drive**
2. 32gb SD Card for Storage
3. Numpad for commands
4. Mouse and Keyboard for Development
5. Four Webcams (360p or 480p with high contrast and good low light conditions)
6. External rechargeable battery for sleep mode
7. Windows GPS Module

8. USB wiring
9. Camera Mounting

Software Design:

1. MPEG4 export
2. Four videos exported as one video file with time, date, and gps location stamps
3. Error flagging

Risk Analysis:

The following risk analysis chart is a breakdown of possible risks that may arise during the life of the project and proposed solution in the event that a risk takes place:

Possible Risk	Rank	Effect	Risk Reduction Action	Risk Response (Action - if it happens)
Significant changes in user requirements	High	Costs to: Time, Quality, Budget	Constant communication with the customer to ensure that the user requirements are being met and agreed upon.	Any changes to the requirements must be agreed upon. If agreed upon, the new requirements will be implemented in the design of the product. Also, the project schedules will be updated to account for any redesign and testing.
Solution's physical size is too large	Medium	Complete device consumes too much room and becomes a distraction to the driver/road-tester.	Main use and location of the device will be, strongly, taken into account during the design of the solution	A redesign of the hardware assembly will be necessary, possibly, including a reevaluation on hardware components
Hardware failure or breakage resulting in a reordering of parts	Medium-High	As the cost of our parts are fairly expensive, the team will go over the budgetted \$500. This may, also, result in a delay to reaching a final project.	Any, if possible, simulations and care will be taken with our components during use and testing. In addition, budget will have to be controlled tightly, in regards to the ordering of parts	The team will have to contact supervising faculty to propose an increase in the budget. In addition, communication to the customer and to the team faculty facilitator will be necessary.

Poor video/audio quality	Medium	This may cause data to be missed or render collected data unusable depending on the quality of the file	Constant testing of the device, including quality, will be taken and recorded at each milestone of the project	A reevaluation of the placement of the audio/video component will be necessary. If the quality is considerably poor, a replacement component may be necessary.
Loss of component	High	Require a reordering of part, possibly pushing the project over budget. Delay in the release of the full product.	A fairly in depth inventory check on all of our components, particularly the costly parts. Items will be stored in either in the lab locker or in a trustworthy location.	The part will be reordered and, if necessary, a prioritization of tasks will be agreed upon by the team. Appropriate faculty and customer will be kept informed on the situation.

Project Management Plan:

Personnel and Breakdown of task responsibilities

Although, many of the tasks will be implemented in working together as a team, a general breakdown of task responsibilities are described below:

Danielle Guir - Team Project Management, Software contributor. Responsibilities include, but are not limited to, the contribution to the design, programming and testing of software architecture and implementation as it relates, but is not limited, to the display and compression, generally, the post-analysis of the data gathered. Administratively, maintains and helps to improve the quality of the team's design process, schedules meetings, reports meeting minutes, progress, any problems, and any expenditures to the team facilitator. Maintains team task list, timeline, and calendar, monitors the budget.

Rudina Alhamzi - Team Documentation, Hardware contributor. Responsibilities include but are not limited to design, assembly, and testing of hardware as the project progress. In extension, providing team support as it relates to the written communication in the team's engineering design process. With the use of software tools, will coordinate the preparation of the written reports, coordinate peer-editing of documents, and maintain a documentation portfolio for the team.

Joe (Yizhou) Jiang - Team Presentation Prep, Hardware contributor. Responsibilities include, but are not limited to, the design, implementation, and testing of the hardware, including the

assembly of the components. Additionally, the responsibilities extend to the coordination of the preparation of oral reports, coordination of peer evaluation of presentation reports, maintenance of the teams documentation portfolio, and the maintenance of the preparation of posters at the end of the term. Also, Joe is responsible for uploading presentations on team's website.

Scott Hansen - Team Webmaster, Software contributor. Responsibilities include, but are not limited to, the contribution to the design, programming and testing of software architecture and implementation as it specifically relates to the integration of the microcontroller OS and setup. In addition, Scott will maintain the team website - including the maintenance of the Unix directory, web page coordination, and CD-ROM writing of the project.

Jason Ostroski - Team Lab Coordinator, Software contributor. Responsibilities include, but are not limited to, the contribution to the design, programming, and testing of software architecture and implementation as it relates to the data gathering, which includes but is not limited to: GPS location, time stamping, audio and video storage. Responsibilities also extend to the smooth functioning and appearance of the lab (2221 Engineering Building). Additionally, Jason will coordinate the ordering of parts for the team, ensure the lab stays clean and orderly after the team leaves the lab, maintains the inventory on the parts, and will report any problems noted with the lab equipment to the ECE shop.

Assumptions while planning

- Changes in functional and technical requirements during the life of the project may have an impact on the schedule and overall release date.
- Customers will be kept up to date with weekly update meetings

Facilities and resources

A majority of the development of the project will take place in the Senior Design Lab (2221 Engineering Building). Any additional software will be researched and obtained through open source resources - as much as possible. The primary programming language is currently undecided. Options will include, but are not limited to, C#, C, C++, Java, or any other high-level programming language.

Timeline

Please refer to the current Gantt Chart - the .mpp file has been attached along with this document.

Budget:

Since the current “Blue Pirate” testing implementation is costing Bosch to spend around \$1300-\$1500, the team is determined to reduce the cost by half or more if possible by allocating the budget to a maximum limit of \$500.

1.The ASUS nettop is listed at \$200. This is necessary for the backbone of the project and it is critical to have high processing power, while being small and compact.

2.Four webcams will need to be purchased. These are for the video capture aspect of the project. At least two webcams will need to be a higher quality to view road signs, while the other two can be a lower quality to view the cluster and instruments. Two lower-end webcams could be purchased for around \$20 each, while the other two higher-end webcams are estimated to be upwards of \$40 each.

3. Another purchase is a GPS receiver for \$60. GPS coordinates need to be constantly collected, then over layered on top of the video to provide location.

4. A USB hub is also another purchase, with a price tag around \$15. The USB hub will help in testing so the team can attach peripherals such as a keyboard and mouse, without losing USB ports used by the cameras and GPS.

5. For storage, 32GB SD card would provide ample storage to place the video data, while only costing \$25.

6. An external battery pack will provide a constant charge to the system while in sleep mode to prevent the risk of shutting down and missing video data. Cost varies for mAh from around \$50.

The list of these items brings the running total to \$470.

References:

-*Bosch*. Automotive technology Press releases, 25 Jan. 2013. Web. 21 Sept. 2013.
<<http://www.bosch-presse.de/presseforum>>.

-ECE480, <<http://www.egr.msu.edu/classes/ece480/capstone/>>.