Data Contact

Hani Elgebaly, Ph.D.,
CEO AvidBeam Technologies,

https://www.linkedin.com/in/hani-el-gebaly-11a965/

Skype ID: elgebaly2000

Voice & Whatsapp: +201068848777

www.avidbeam.com

Egyptian Consortium

Private company: AvidBeam

Research Entity: Cairo University

Introduction

AvidBeam is specialized in big video data analytics. AvidBeam has two main product lines, a scalable platform for video processing “ATUN” and a collection of computer vision plugins and libraries “ViBEs” for various applications. This document provides a brief introduction to AvidBeam product line as well as a short description of the proposal joint R&D.

AvidBeam Product Line Summary

ATUN is a scalable video processing platform. It has a standard plugin interface so that different computer vision, video processing, or similar plugins can be easily plugged into ATUN for scalability. ATUN is responsible for scaling the plugin, storing plugin results into database, and providing a set of web interfaces as well as an API for accessing stored data for search, filtering, query, etc.

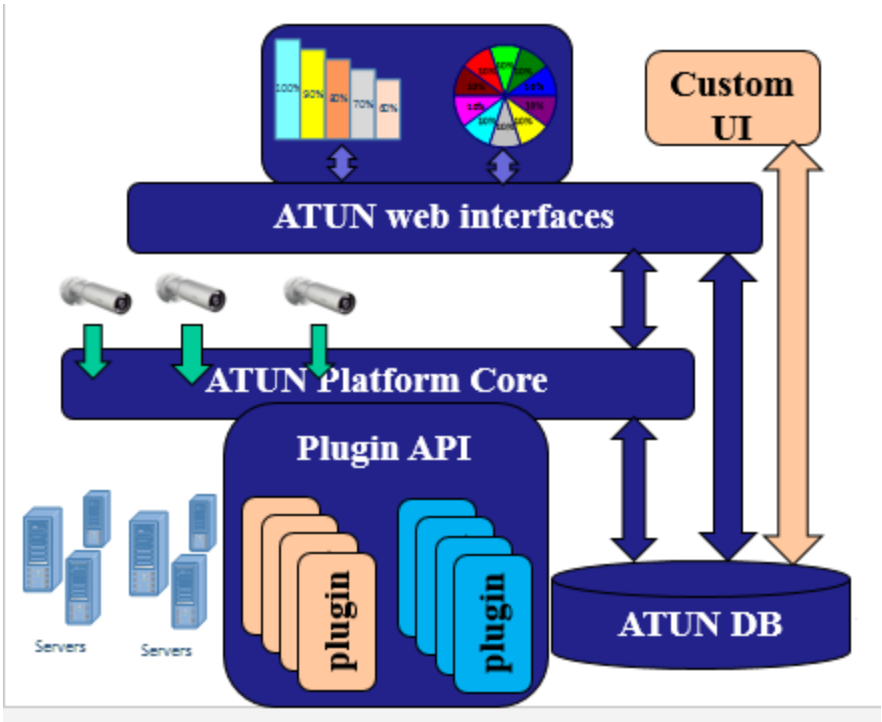

Figure 1 AvidBeam ATUN Platform

Using ATUN as a scalable platform, AvidBeam has produced several products for different market sectors. Those products use ATUN for scalability and extend/customize ATUN web interfaces for more enhanced user experience. Currently AvidBeam has the following ViBE™ products.

1. ViBE-P: Targets Parking and Traffic applications. Supports features such as automatic license plate recognition (ALPR), car counting.

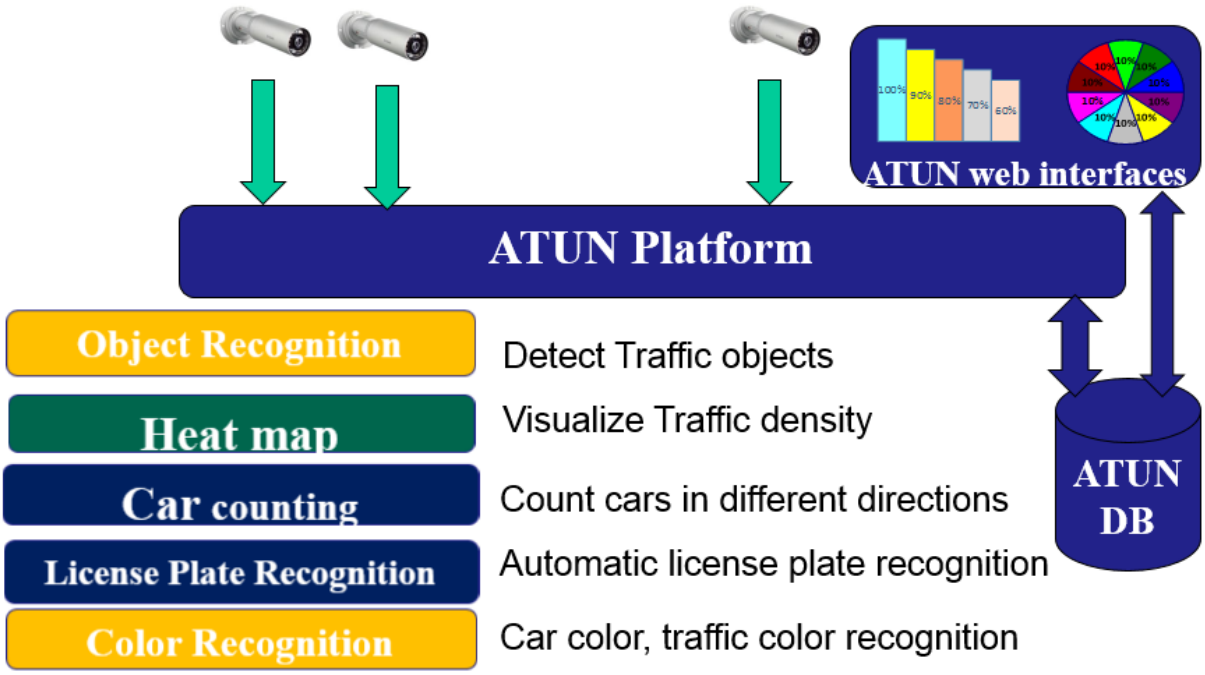

Figure 2 AvidBeam ViBE-P main building modules

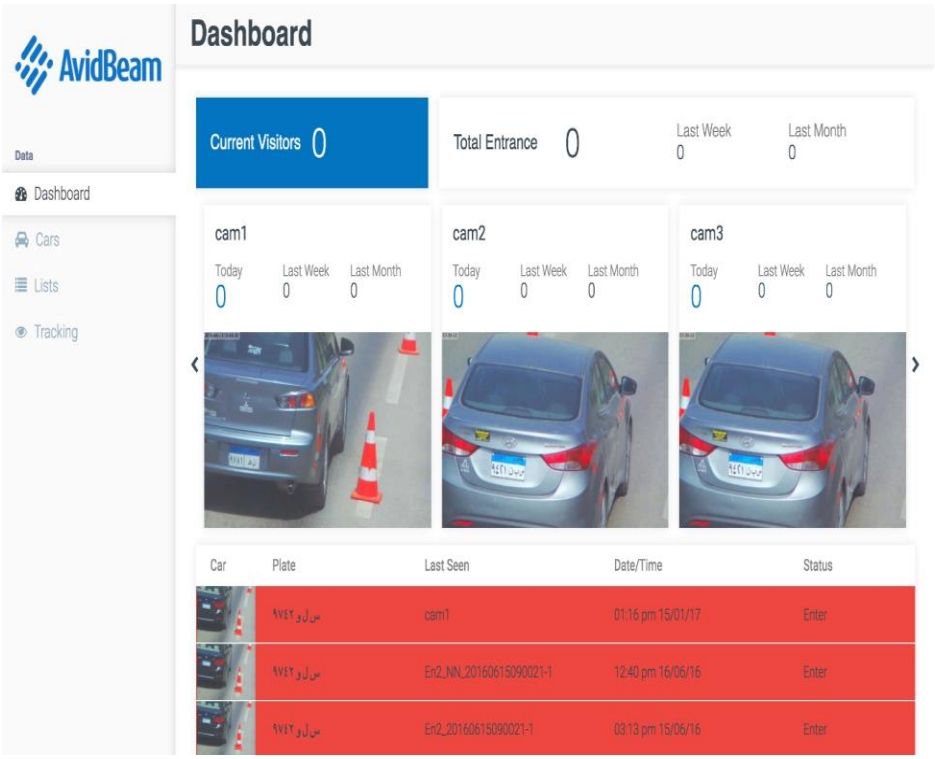

Figure 3 ViBE-P Sample Web Interfaces

2. ViBE-R: Targets Retail applications; supports people counting, heat maps, pathways, age, and gender classifications.

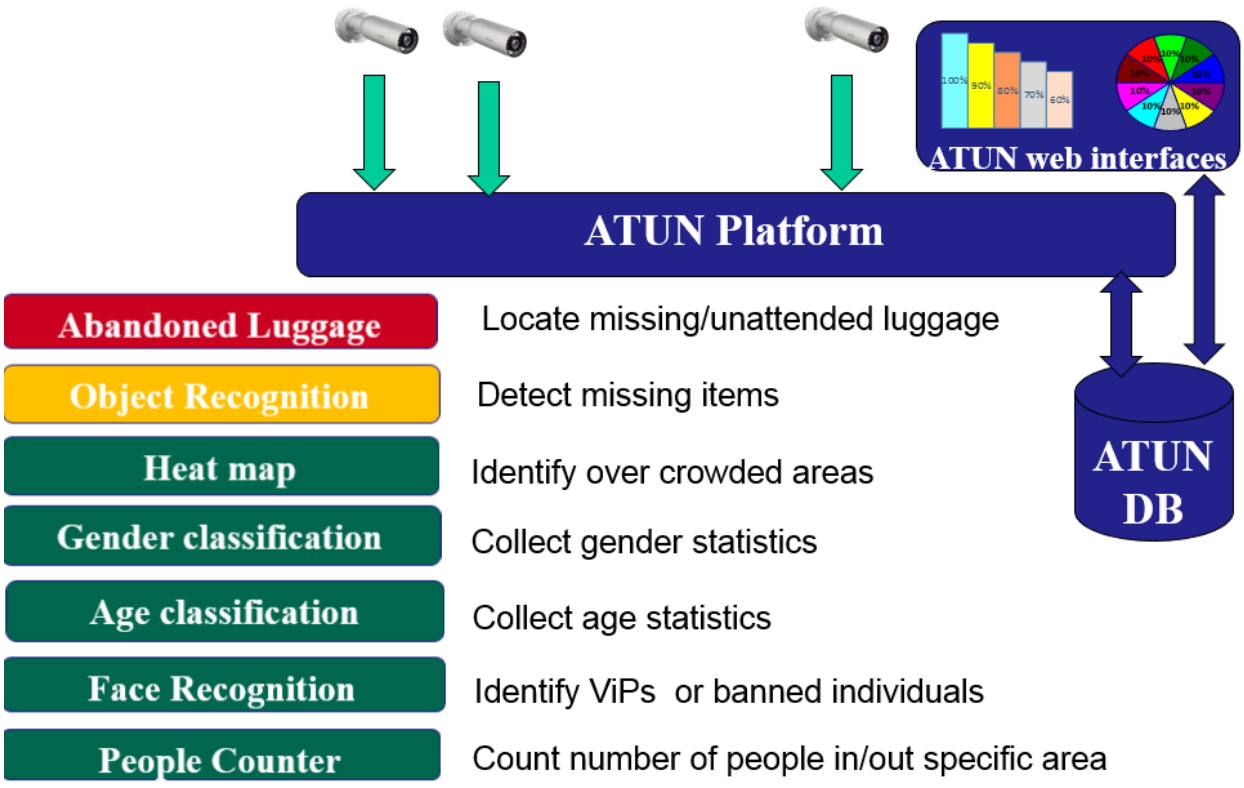

Figure 4 AvidBeam ViBE-R main features

Figure 5 ViBE-R Sample Screen shots (Hot spot, In/out statistics, and intruder report)

3. ViBE-S: Targets security applications; supports intruder detection, abandoned luggage detection, specific object detection and classifications.

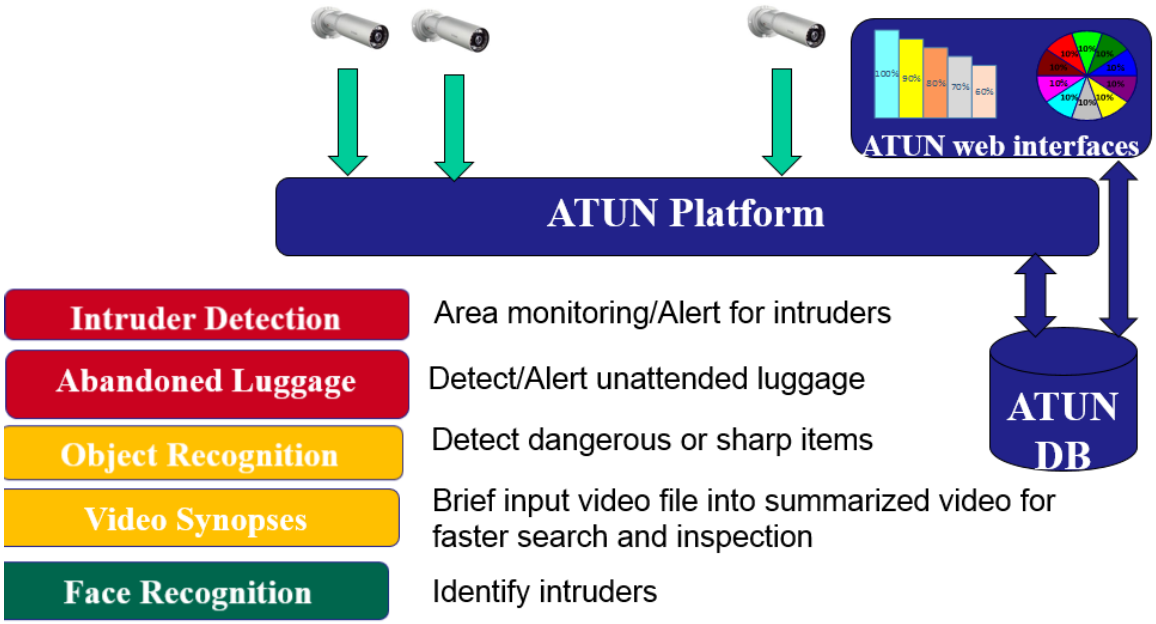

Figure 6 ViBE-S Main Modules

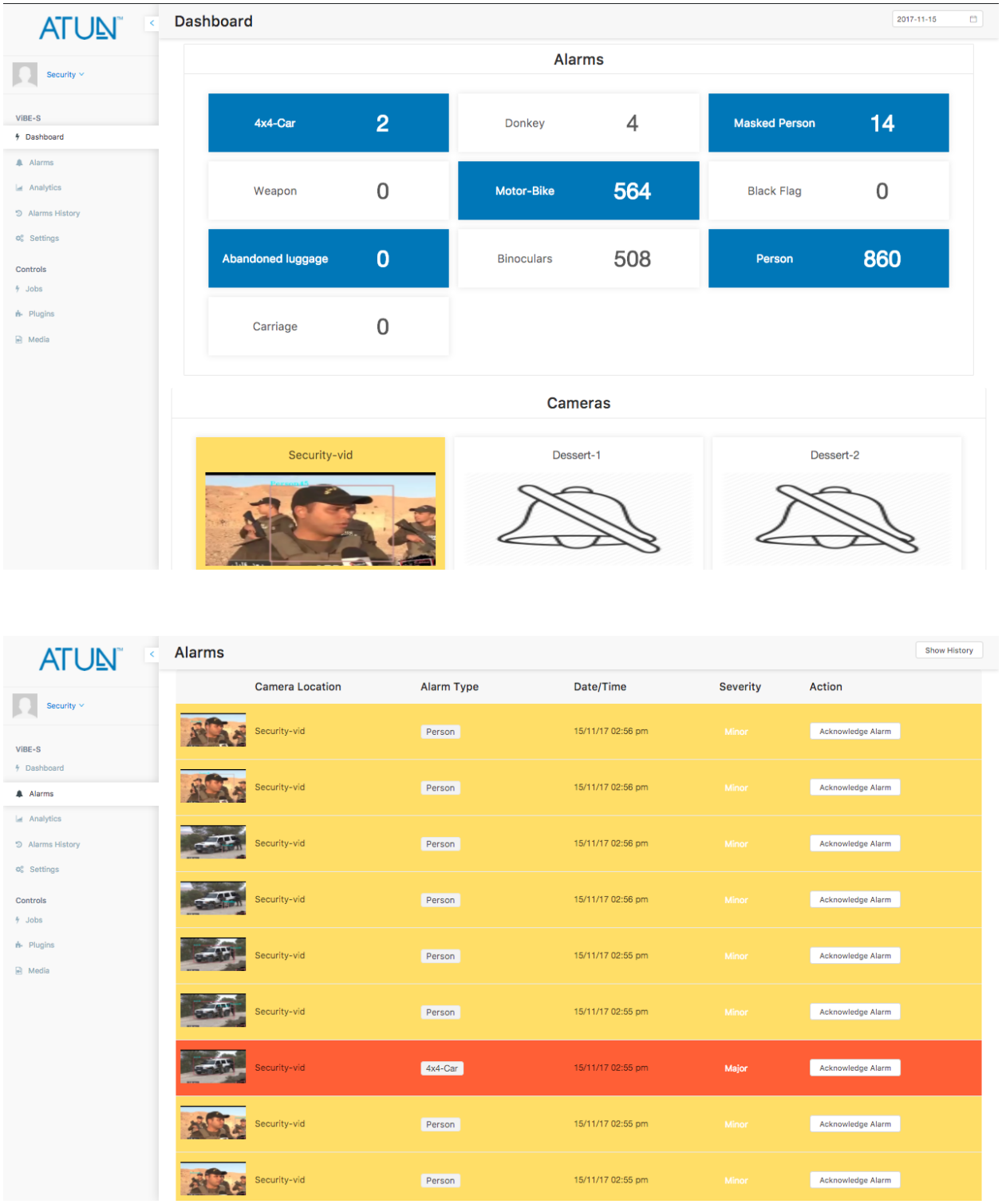

Figure 7 ViBE-S Sample Web Interfaces (DASH Board and Alarm Listing)

4. ViBE-A: Targets ADAS market. Support automatic and manual annotation for both video images and Lidar image data. This is a mature prototype that should become a robust product in 2018.

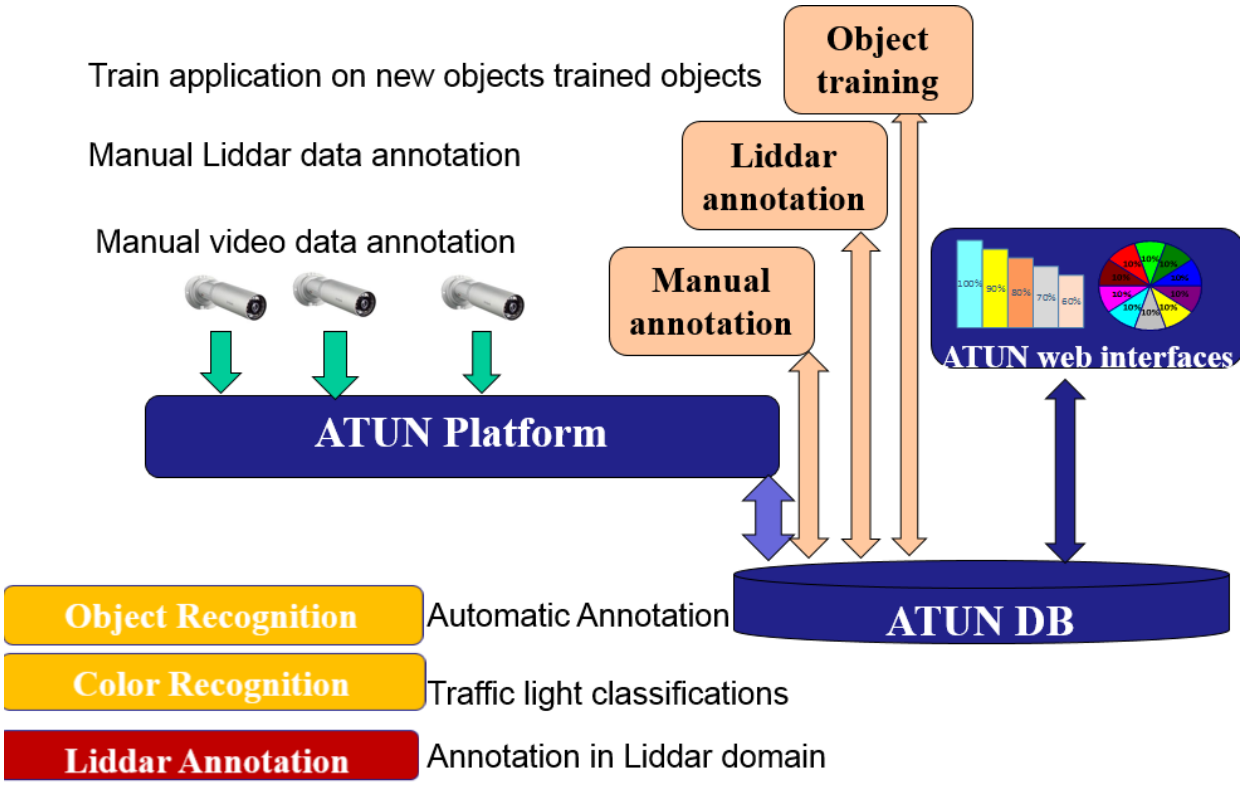

Figure 8 ViBE-A main modules

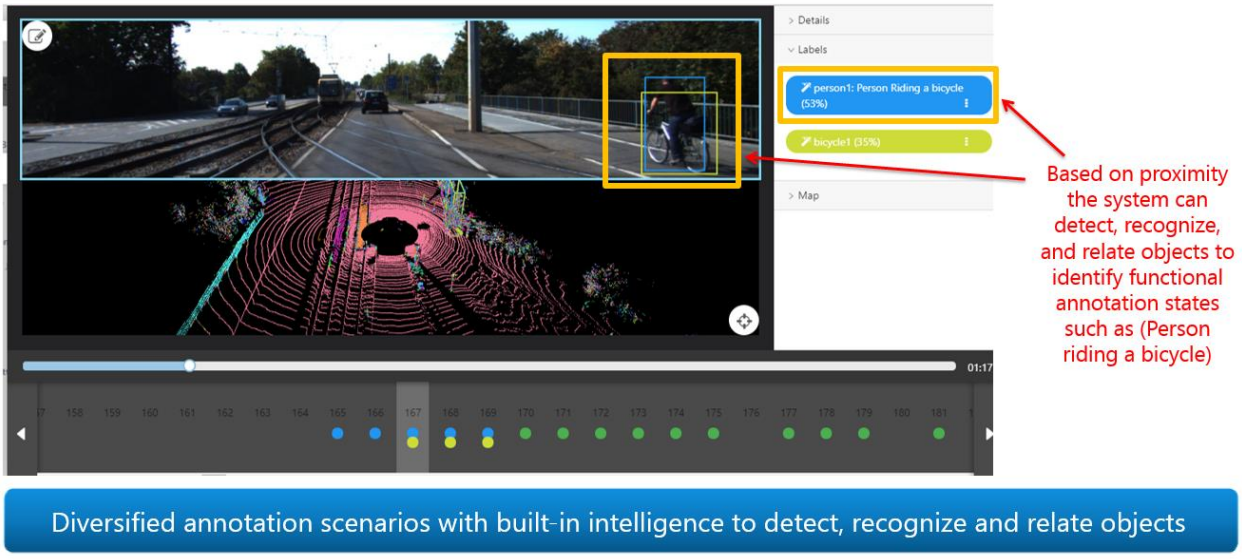

Figure 9 ViBE-A Sample Annotation Tool

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Automatically Annotate Checked-In Data

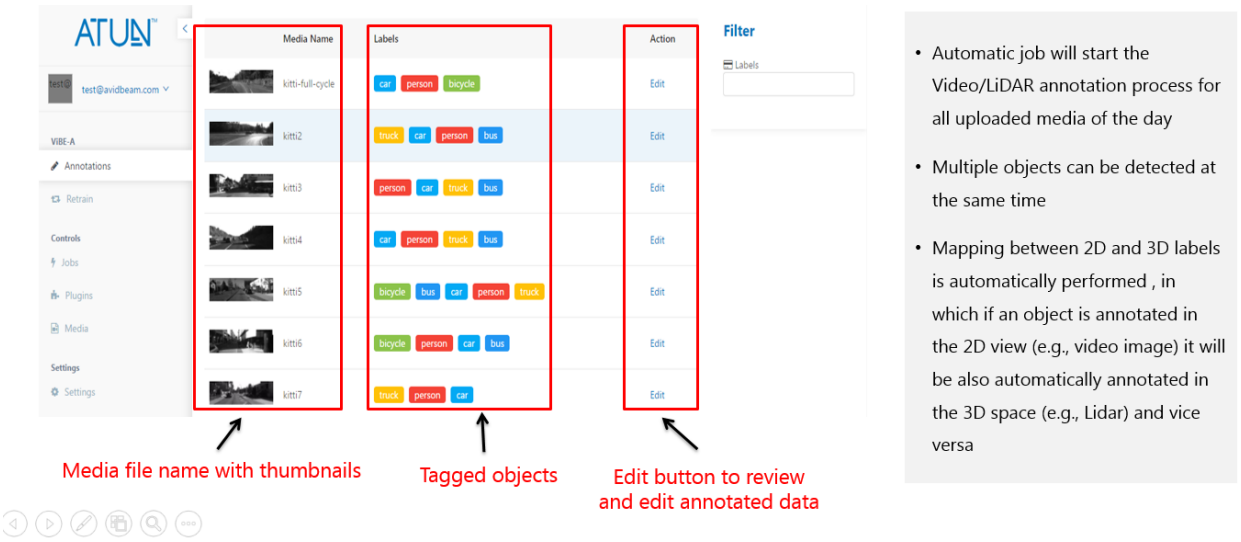


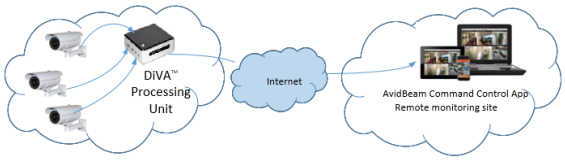
Figure 10 ViBE-A Sample Web Interfaces

AvidBeam ViBE-A supports both Automatic and manual annotation as well as works with both video and Lidar data. This is the prototype we would like to focus on for this proposal.

In addition to the products described above, AvidBeam also has a special product “DiVA” which is used for optimizing uploading bandwidth through different optimization techniques (Transcoding, motion detection, etc.)

Proposed Media Splitter/Uploader Component

- Optimize the use of network bandwidth and other resources
- More efficient operation of video flow and management on the network
- Video format aware
- Network-aware
- Client/Context -aware
- Real-time
- Hardware accelerated



AvidBeam’s DiVA™ saves upload bitrate by 30-80% yielding enormous savings in transmission cost

Figure 11 AvidBeam DiVA Product

Proposed Joint R&D

The main objective of this proposal is to extend ViBE-A to provide a full-fledged ADAS solution. Details of covered features in ViBE-A is described in this section. We are targeting adding the necessary features demanded by the automotive market in addition to enhance existing prototype features to be fully compliant to the needs of the ADAS market and safety regulation.

The problem statement is that currently many vehicle manufacturers and vendors of autonomous and ADAS industry collect data on the road using their vehicles. This data will have all vehicle sensor information collected on what is called V-drive which is a hard-disk on the vehicle. This data is taken to the factory to be used for test and validation of the vehicle engines using a concept called system in the loop. The idea is to extract proper scenes and scenarios compliant with safety standards and regulation for testing, validation and training of ADAS and autonomous vehicles.

In order to process this data, the vendor usually assigns manual annotators to generate the ground truth of the objects encountered in the collected videos and LiDARs/Radar. The manual annotator will have to go frame by frame in the video and LiDAR data and do the manual editing of all encountered objects of interest. Example for objects of interest in the scenes include person, bicycle, vehicles, traffic light, traffic sign, animal, truck, railway, curb, etc. This is an extremely tedious job for manual annotators knowing that an average car can produce 8-10 hours of road data daily which translates roughly to 864,000-1,080,000 frames per day on best case scenario at 30 frames per second. This makes the manual annotation an expensive job and requires the intervention of automated tools and artificial intelligence to speed up this process.

Hence, the concept of automatic tagging and annotation was invented. While this process could possibly save more than 80% of manual labor cost, manual annotators will not go away. There is a need still for manual annotators to verify that the automatic tagging was done right until we reach the ultimate goal of 100% accuracy on automatic tagging which is still not achievable in the near term but tools and deep learning development are accelerating the march towards this goal.

ViBE-A was described briefly in the previous section. In this section, we describe more details about the supported features, the work flow, and the remaining features.

Figure 11 display a typical scenario for a full-fledged ViBE-A.

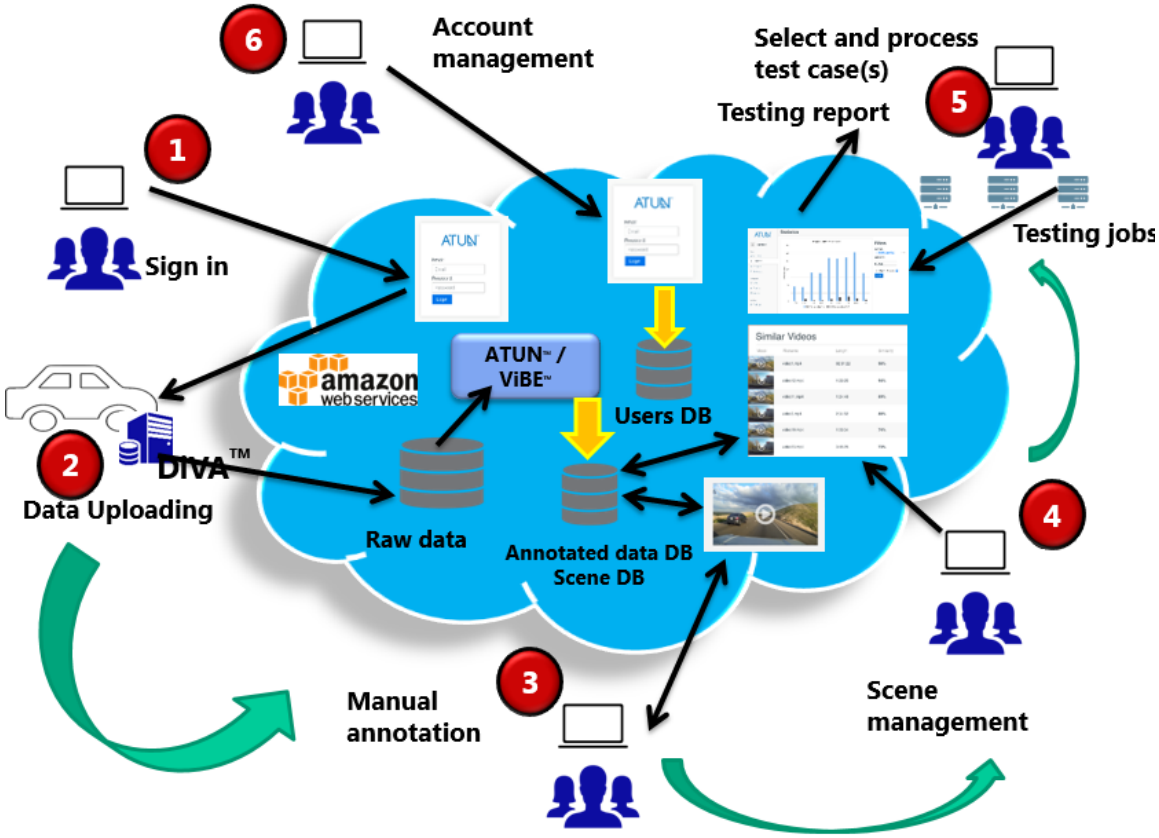


Figure 12 ViBE-A data flow

1. User sign in to his/her account
2. User upload data from car or from local site to the cloud where ViBE-A reside where automatic annotation is executed
3. manual annotation is then performed on the automatically annotated data
4. From scene management, user can search for specific objects, list annotated media files, and export results
5. Test management: (not currently supported) The solution Creates, or Selects a specific scene for a certain test scenario(s) and export the ground truth data.
6. User account management

Detailed Description of ViBE-A

ViBE-A Features

1. Automatic annotation (Figure 10). Uploaded video data are automatically annotated using AvidBeam annotation plugin. Annotation results include
    a. Object x,y, and z position

   b. Object classification (ViBE-A supports 20+ object classes and this number can be increased easily)
2. Manual annotation (Figure 9): annotated data can be edited and modified using AvidBeam manual annotation tool. Manual annotation works for both video (image) as well as Liddar domain
   a. Annotate in image/video frame
   b. Annotate in Liddar domain
   c. Display both video and Liddar point cloud data
3. List View: each media file can be listed on a frame by frame bases and the objects in each frame is listed. The list view supports also query mode where client can search for specific instants
   a. Filter media by camera or by object type :within the same video
4. Re-Training: ViBE-A allows user to add new object and retrain the solution to generate updated models.
5. ATUN-based features
   a. Scalability: support many cameras
   b. Database management
   c. Query support
6. Other Misc. features
   a. Synchronization between video and Liddar data
   b. Exporting result in a JSON file

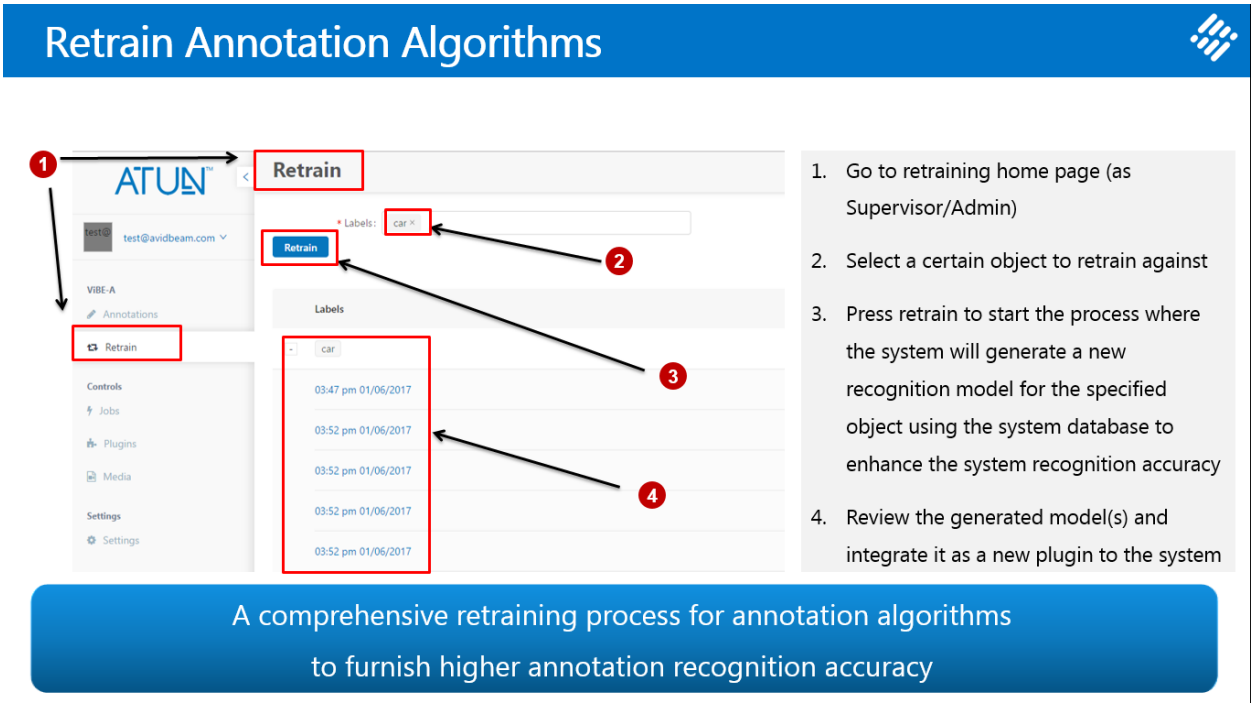


Figure 13 ViBE-A Retaining web Interface

Proposed Extensions for Prototype Conversion to Viable Product

Examples of proposed extension elements to the prototype may include

1. Extend support of existing LiDAR sensor including the ability to process LiDAR PointCloud information directly, conduct direct labelling on LiDAR images and extract additional data not currently available from video such as distance, depth, etc.
2. Adding support for other sensors such as Radar (Object detection in Lidar domain) and maybe ultra-sonic. This will include investigation of proper representation techniques of these sensors by the tool and the most feasible way to extract the desired information and furnish to the user in the most user friendly format.
3. Investigation of fused video and LiDAR images. This is an advanced research topic currently pursued by the automotive industry. This is about combining both video and LiDAR in one frame and conduct the annotation for both on a single frame. This way the annotator can get the look and feel of the object as well as the depth and the distance information. This is usually termed as 3D and 4D fused LiDAR images.
4. Support new features (semantic segmentation, curb detection, lane detection, car speed detection, object distance estimation, etc.)
5. Support different input format such as RTMaps, ADTF, RoS & others. Currently LiDAR is made available in PointCloud format as raw data from LiDAR manufacturers but vendors collecting road data package the video and other sensor information in different defacto standard formats. Dealing with these formats is essential for reaching the potential market of this tool.
6. Support multiple cameras (video stitching) which is extremely important for panoramic view.
7. Testing and validation of this tool to make it of acceptable reliability and compliance with safety regulation of car manufacturers.
8. We expect to test the tool using data from public domain. There are a few good public data sets currently used for this purpose.

Project Timeline

It is expected that this project duration will last around ~15 months. The project will be divided into packages owned by the project teams. We estimate the project will be executed over five major milestones. Each milestone will last for about 3 months. Each milestone will introduce new features and results achieved in the LiDAR domain.

Summary

This proposal is about extending the existing AvidBeam prototype to support LiDAR annotation. This project addresses a few challenges in this industry including efficient algorithms for augmenting video information with more in-depth information about the vehicle ride. It also addresses novel schemes for dealing with fused LiDAR and video images to conduct the annotation more efficiently and in significantly less time than conventional ways. In addition this project employs machine learning techniques for improving the accuracy and the confidence level. This tool is in high demand by the industry and it is expected that this demand will rise more and more as we approach the era of autonomous vehicles becoming mainstream.