

DESCRIPTION AND TECHNICAL SPECIFICATION



AUTOMATIC NUMBER PLATE RECOGNITION SYSTEM

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Introduction

Why Talon?

Talon provides all that may be needed from an Automatic Number Plate Recognition System (ANPR):

High Accuracy	Reliable recognition performance allows system to be deployed with confidence. Performance typically in excess of 95%.
Modular Design	Cost-effective, application specific solutions can be provided. Can accommodate up to 28 cameras per unit.
High Speed of operation	Can recognise many vehicles per second travelling at speeds of over 200 kph - well in excess of typical highway speeds.
24 hour / 365 day operation	Night time operation with visible floodlighting or with dedicated Multi Level Infrared Camera Systems, in all weather conditions.
Automatic "in Picture" Trigger	No requirement for external system triggers such as inductive loops or light beams. The system will recognise a plate that appears anywhere in the video image.
International Capability	Talon will read many different nationality number plates. No limit on the number of nationalities enabled.
Positive Vehicle Identification	Number plate numbers can be entered in a number of internal or external databases. System alarms are generated when one of those plates is identified. Alarms can be routed to different users according to need.
Industry Standard Platform	All Talon applications are implemented in Microsoft operating systems and permit multi-tasking and providing for easy operating system upgrades.
Ethernet Compatible	Allows easy TCP/IP integration with external application software.
Image output	The system can provide images of both the number plate and the vehicle for verification purposes.

The Need for Talon

As the number of vehicles using the roads increases in a seemingly uncontrollable fashion, it becomes inevitable that any task requiring vehicles to be identified individually on the open road, can no longer be accomplished manually. The speed of vehicles and traffic density ensures that no human observer can read and note down number plates quickly enough to record all passing vehicles. Furthermore, the search for one particular vehicle from millions of vehicles of interest cannot be achieved manually. Talon offers a value added benefit for slower speed applications such as access control, which can be done manually because ANPR reduces the manpower. It automates a labour intensive task and is more accurate and reliable.

Talon - Why it Works

There are a number of key reasons which make Talon the highest performance and most robust ANPR system available worldwide. These are:-

- | | |
|--|--|
| Proprietary Recogniser Assembly | Talon takes video from cameras directly into the assembly which has a frame grabber and six DSP's. The architecture overcomes the computer backplane speed limitations and allows up to 28 cameras to be connected to one Talon PRU. |
| Trained Neural Network | The DSP's use trained neural networks to read number plates. Better results are obtained particularly on images at more difficult times in the real environment. |
| Multiple Processing | Sophisticated probabilistic context checking is done by the PC on all the DSP results. |
| Confidence Levels | Each character has a known confidence of read accuracy. This and other data such as spacing, allows the PC to post the best result for each vehicle. |
| Experience of Cameras | The best setup and choice of cameras for ANPR is a specialist topic. Appian had over 10 years of experience in the design of cameras dedicated for ANPR. The best results are obtained from the best combination of cameras and Talon. |
| Development History | Talon is the result of the most extensive development program undertaken by any ANPR company. Started by Racal Electronics in 1993 the system has been continually refined and developed to maintain its market leading edge. |

Leading Edge Technologies - The Neural Network Approach

Talon represents an alternative direction to conventional OCR template or rule based solutions in solving the challenges associated with ANPR. Instead of relying on these conventional processes Talon uses pattern recognition techniques incorporating neural networks. Neural networks offer much greater potential in terms of performance than conventional pattern recognition methods. The networks are not programmed in the traditional sense but are trained by example on a large number of repetitions of character sets. As a result, the network builds a statistical model which focuses on the features making each individual character distinctive, rather than forming a definitive template of individual character shape. **Consequently neural network based techniques are more able to recognise poorly defined, distorted and dirty characters.**

Capability To Read Multinational Number Plates

Understanding and experience of neural networks has enable Appian engineers to build a multi-national neural network. This retains the capabilities of the earlier UK product but recognises number plates of many other countries at the same time. The performance on individual country plates is not diminished, furthermore additional country plate reading capabilities can be added by retraining with new video data. **In a European, cross border, exercise it correctly recognised 95% of all captured numberplates.**

Our system has the capacity to receive in-life updates to accommodate additional nationalities and other software upgrades. Changes to plate formats will be added very quickly when implemented. The hardware is of modular design and can be upgraded as and when new demands are placed upon it.

Application Software

All Talon Database software is based on a single core "engine" to which the specific application/s are added and has been designed to be totally integrated with the Talon recognition software. The Database Engine software utilises Microsoft Data Engine (MSDE), which provides an industry standard interface and an upgrade path for future enhancements, as well as providing security against obsolescence. The software is scaleable allowing easy expansion of the system.

The Talon Database Engine software is designed to work on single platforms but can also be used in server / client arrangements. No third party licences are required; however if the database exceeds 2 GB in size then the Talon Database Engine must be used in conjunction with SQL Server 2000.

Application software to run concurrently with the core ANPR process and the database engine is available as follows:

- ***Talon Spectrum*** - Bespoke software for Policing and Surveillance applications, allowing local and national databases to be interrogated based on the plate read for detection and identification of stolen and wanted vehicles.
- ***Talon Mobile Spectrum***- A special version of Spectrum which offers touch screen technology for use in in-vehicle installed systems.
- ***Access Control / Access Monitoring***- Two software packages providing monitoring and control of vehicular access to controlled areas and sites.
- ***Talon Car Park Management*** - An application that calculates the time a vehicle stays in a car park.
- ***Talon Journey Time Analysis*** - A means to measure time over distance between a number of recognition points for the purpose of speed measurement or for journey time analysis.
- ***Talon Imaging*** - A high quality imaging system to allow wide field of view colour images of vehicles matched to the plate read to be captured and stored. A unique signature is written into each image for enforcement purposes.

Summary

Talon ANPR provides an easy to use, but extremely powerful and accurate system. The system will be backed up by the proven expertise of the APPIAN technical and management teams who are fully experienced in the design, provision, installation and maintenance of ANPR and associated applications.

Talon Description And Technical Specification

Talon Systems Overview

The major element in any Talon system is the Plate Recognition Unit (PRU) also known as the Talon Unit. A video source provides composite analogue video to the TALON Unit which processes the images to produce a log of all number plates recognised, along with time and date stamp, a confidence level and a camera identifier for each log entry. There are many more output fields which can be selected if required.

Talon is based on digital signal processing and PC hardware and has been designed to cover a wide range of applications. The performance requirements of each application dictate the specific hardware build necessary. The basic building element is a Recogniser Assembly containing digital signal processors (DSPs) which perform tasks which include, but are not restricted to, number plate detection and location, character segmentation and character recognition. The DSPs each receive a field of video from a frame grabber, and hold that in video memory. A microcontroller co-ordinates the work of the frame grabber and the DSPs on each board fitted. This part of the recognition process takes typically 150ms on the PCI Recogniser Assembly, but for poorer quality plates or difficult environmental conditions it may take up to 200ms. If there is no detected number plate in the grabbed image, then the process completes in a few tens of milliseconds and the DSP is available to start again.

Once the tasks are completed, any number plate recognition candidate result is passed to the internal PC. The frame grabber will sample the continuous incoming video signal every 20ms (for PAL/CCIR, or 16.6ms for NTSC/EIA) and distributes fields to free DSPs. If the camera is viewing slow moving traffic, then each vehicle will be detected a number of times depending on speed and the geometric configuration of the camera to the traffic flow. After the vehicle has left the field of view of the camera, the PC collates all information about the vehicle and presents one answer to the log and screen display. Where the application is to open a barrier, and the plate stays in the field of view until then, Talon can output the plate read with the "early log" parameter set. That requires the exact same result to be obtained a pre-settable number of times, which guarantees a known accuracy.

The Recogniser Assembly is manufactured with two DSPs fitted, and four more mounted on two daughter boards. There are four video input connectors, scanned sequentially by the frame grabber. For low speed traffic, each Recogniser Assembly can receive video from four cameras, and Talon is exceptional in being able to take 28 cameras into one PRU. This modularity and consequent competitive price per lane is a major advantage over software only products that can take only one (or maybe two) camera inputs.



When using Talon to read open road traffic travelling at Motorway speeds, it is recommended to use only one camera input per board. This ensures that no fields are missed given that there will be very few at high speeds. The number of fields available is also dependent on camera height and dip angle to the road.

Appian has considerable systems and project management experience, and has automated the deployment planning process with spreadsheets to compute parameters for different cameras and locations. The company has particular experience of camera design for ANPR application.

Proprietary hardware is key to Talon performance, but more so is the use of trained Neural Networks (NNs) implemented in software and used by the DSPs, which are described in following sections.

The Talon Plate Recognition Unit (PRU)

The TALON PRU is a highly modular device and is based on an industry standard computer with all the expected components; power supply, hard disk, CD, floppy drives and PC card. Latest generation CPU and operating systems are utilised including Windows 2000 and 2.4GHz CPU.

The key to the success and performance of Talon is the use of proprietary hardware in the Recogniser Assembly. Up to seven assemblies can be plugged into the PC back plane, and each can receive up to four different camera inputs. Each assembly has a frame grabber, microcontroller and six digital signal processing (DSP) chips. These DSP's run the neural networks and each provides a number plate read which is fed to the PC.

The function of the PC is to choose the best result of all the results for each vehicle, which is made possible because each character recognised has an associated confidence score. The DSP's also transfer a digital image to the PC which can be a full size video field or a reduced plate patch image. The PC slots can be used for network cards, colour frame grabbers or application specific cards such as relays to operate barriers.

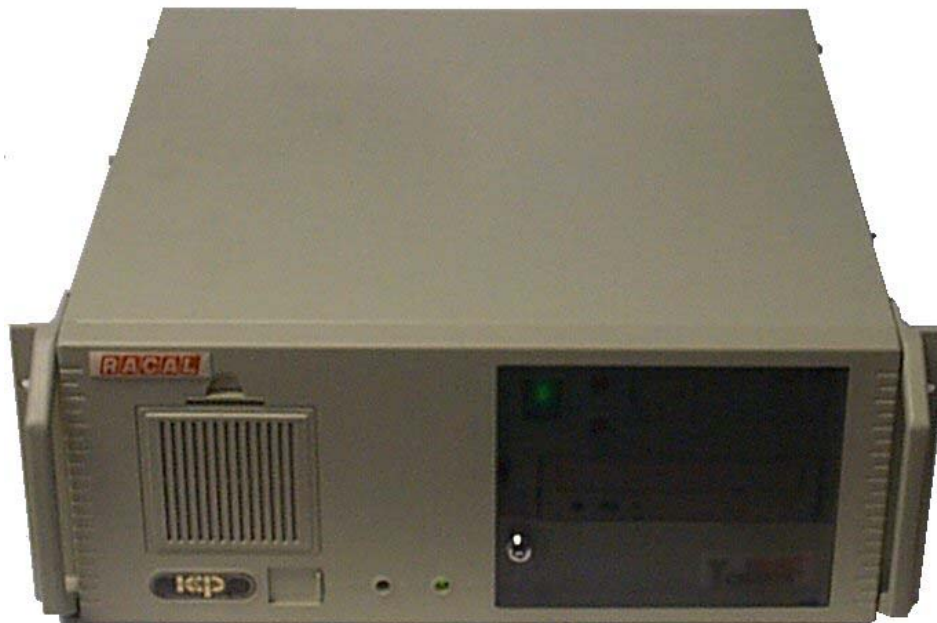


Figure 0-1 19-Inch Rack Mount Talon Unit

Talon Recognition Unit Minimum Specification

Hardware

- 14 Slot PC Chassis - 300 W PSU (19" Version)
- 1Ghz Processor Card
- 10/100 M bps Network Interface
- 256 MB RAM
- 40 GB Hard Disk Drive
- CD Writer
- Floppy Disk Drive
- Removable hard disk cradle

Software

- Windows 2000 Professional
- Ghost Software

Optional Items

- Keyboard
- 17" Monitor
- Sound Card and Speakers

Camera Choice

The choice of camera depends largely on the application and deployment of the system. The system is designed to operate with standard CCTV cameras, avoiding the need to use expensive, high resolution equipment. The cameras may be monochrome or colour but, in any event, only the black and white signal is used for number plate recognition.

An option which has been found to be particularly effective against reflective number plates is the use of an infrared (IR) sensitive monochrome camera associated with a collocated pulsed IR light source. This produces a very high contrast image of the plate ideal for the purpose of number plate recognition.

Image Output and Storage

A further development of this camera system has produced a dual camera in a single weatherproof housing. The dual camera comprises of an IR camera which is used for recognition purposes and a colour camera, adjusted to produce an image with a wider field-of-view to produce supporting video data. This video is fed to a framegrabber and using image compression facilities to allow supporting images of the vehicle, tagged with a number plate number and a time and date stamp to be stored to disk.

System Operation

The operation of the TALON UNIT is fully automatic after initial set up, requiring no further operator intervention.

Video from a camera (or recorded video from a VCR) is fed to the recogniser module in the TALON UNIT. The frame grabber captures fields of video and transfers them to the memory associated with one of the DSP units on the recogniser module. The image is scanned for the presence of a number plate.

If no number plate is detected the image is quickly rejected and the DSP unit made available for a new field for analysis. If a number plate is detected in the image, a trigger is caused which initiates a suite of software recognition algorithms. These algorithms identify the position of the plate in the image, extract the plate image, apply geometric distortion compensation if necessary and segment the plate into individual characters.

Each character is then fed in turn into a software neural network associated with the DSP unit. The network produces an estimate for every character input resulting in a string of characters, which is its best estimate for the number plate. Multiple DSP units provide a degree of parallel processing to ensure that many images may be analysed for each passing vehicle. Post-processing of the resulting character string then ensures that only one entry is placed into the log for each number plate seen and that the entry complies with the appropriate nationality syntax rules governing the format of the plate.

A keyboard and VGA monitor acts as the man machine interface in order to access the database facility and to change system parameters.

The external trigger gate may be required if the system is being deployed for speed or red light enforcement and in many car park applications.

Talon represents a breakthrough in number plate recognition technology. The neural network approach imparts some intelligence to the pattern recognition technique which ensures that Talon continues to work well in poor/marginal road and weather conditions.

Digital images are firstly captured and transferred into one of the DSP modules. Each DSP module contains identical signal processing algorithms in software. However, during set-up, it is possible to configure certain essential parameters, mainly centred on the camera and number plate geometries, the type of illumination employed (visible or IR), and the triggering. The camera deployment geometry, especially when the distance between the vehicle and the camera is small, can cause distortion of the characters on the plate. Algorithms to compensate for this are included in the software. Since multiple cameras can be connected to a motherboard, these parameters are set up for each camera. In addition, such items as average number plate size and rotation are set. The image characteristics associated with ALPR using visible or IR illumination are subtly different and so the system must be informed as to which type of data is being

This diagram illustrates the algorithmic sequence of events that take place in each DSP module every time an image is analysed.

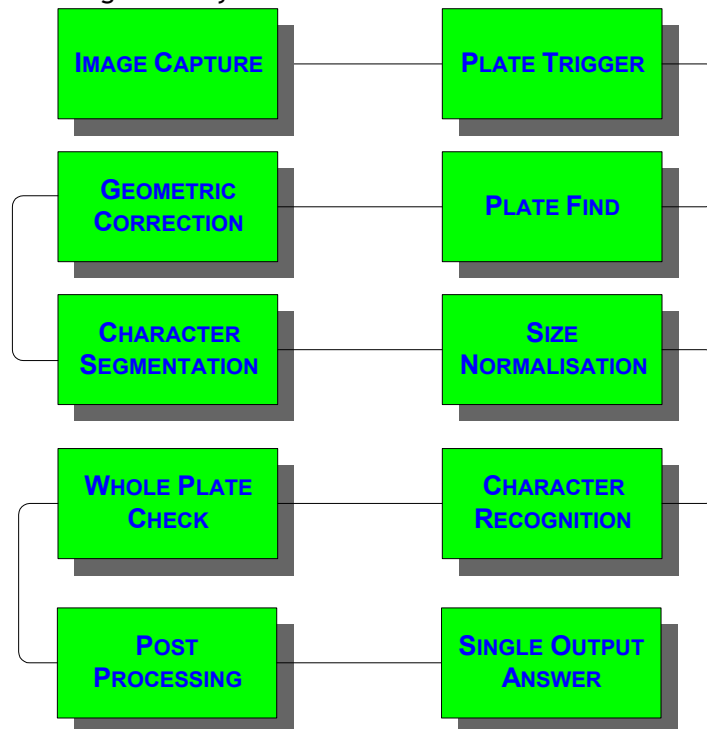


Figure 0-2 Talon Recognition Process

Triggering can use either an external trigger, or more commonly, an in picture automatic trigger. The automatic in-picture trigger mode continually captures video fields and searches for plate-like structures. Fields are quickly rejected if no such structure is found, but detection of a plate then initiates the recognition process. In either case, a plate once detected is then isolated and its size and aspect ratio estimated. Talon is capable of triggering, successfully, over a wide range of plate sizes (which can often happen as the vehicle passes through the field of view of the camera). Algorithms for deskewing and derotating the detected plate are then applied if necessary.

The next step is to segment the plate into its individual characters. This can be implemented in a number of ways, but image manipulation and character size estimation in the presence of noise, distortion, dirt and other misleading background icons, can result in complex algorithms. In some ways, the success of this operation is the key to overall recognition success. Usually, some level of normalising of plate size will be performed within the segmentation algorithm. The algorithm must be able to detect both rectangular and square format plates. It must also be able to cope with rotated plates. Vehicles observed on straight, level roads still exhibit plates which can vary ± 2 degrees to the horizontal. In a mobile scenario or when fixed cameras are poorly mounted, fixed rotation offsets or vehicle to vehicle rotations can vary much more. Talon is capable of compensating for rotations of ± 10 degrees if required.

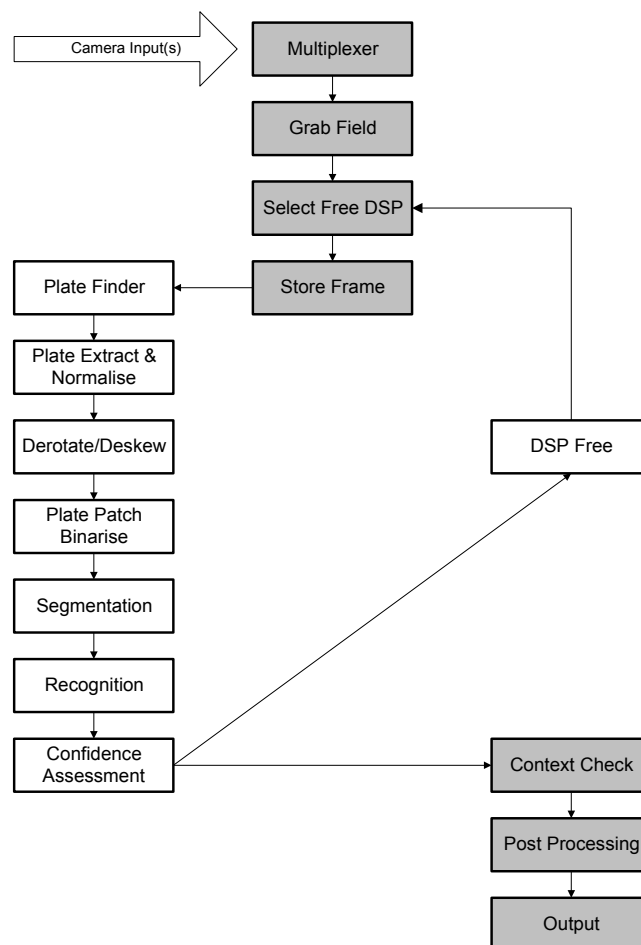


Figure 0-3 Overall Software Functionality

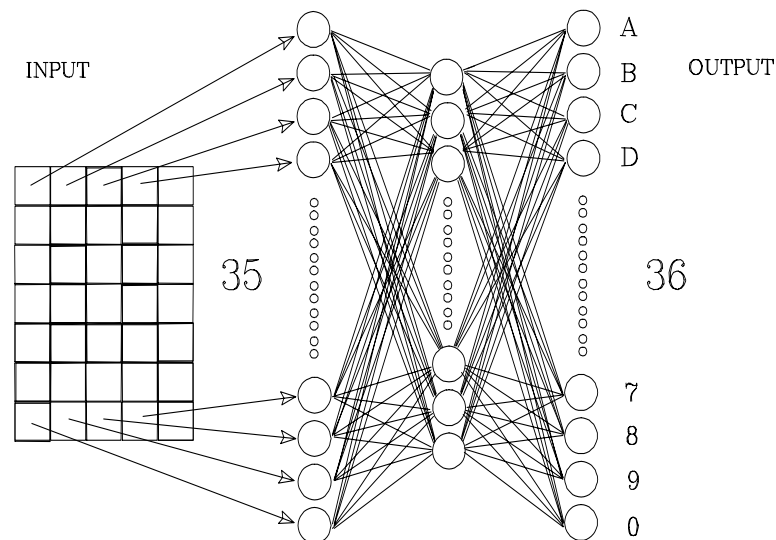
Character recognition now takes place, followed by syntax checking of the final plate registration. Obviously, the overall performance of a plate recogniser relies on the robustness of all algorithms. Recognition will not be reliable unless the pre-processing (plate location, segmentation and normalisation) has provided isolated characters of as good quality as possible. With sufficient processing power, a number of solutions to the number plate may be produced as the vehicle enters, passes through and leaves the field of view of the camera. Post-processing allows further use of these multiple solutions to produce the most likely answer. All results are stored with a camera identifier, recognition confidence level and date and time stamp. The confidence level parameter may be used to filter the data entering the log. In some applications, the resultant number plate estimate may be compared to a locally stored database of many thousands of entries. This provides the ability to flag users when specific vehicles of interest are detected by the Talon system.

Neural Network Technology

Neural network techniques do not rely on a set of pre-programmed rules. Instead, a network consisting of a multiplicity of interconnected nodes with gain factors or weight applied between each node is trained to convert some input source set into a set of alternative results. In this application, the input is a two dimensional array of image pixels, extracted from the image containing the number plate, and the output is the set of all possible results, in this case, the 26 alpha and 10 numeric solutions.

A neural network method can be developed into a very adaptable pattern recognition engine that recognises patterns from a set of possible patterns. The structure of the neural network has to be carefully chosen, not only to suit the application, but also to ensure recognition can be achieved in an acceptable time. Such a neural network must be pre-trained. This is achieved by using a training algorithm that is shown many hundreds of examples, both good and bad, of each pattern that is to be recognised in the future. The required output solution for each input is declared by human operator, and the machine builds up an understanding of the salient differences between each member of the training set.

Figure 0-4 Simplified Architecture of a Neural Network for Character Recognition



Knowing the input and the expected output, the training algorithm modifies appropriate weights to enforce one output solution (the correct one) and downgrade all others. If examples of different fonts, typical geometric distortions, rotation damaged and other imperfect characters are included in the training set, then these variations for each character are accommodated and lumped together.

Training must be performed very carefully. Human mistakes, such as providing the wrong answer for a given input will degrade the performance of the system. Properly trained, this technique is very powerful at capturing real world variation. Once training is completed, the structure and appropriate weights within the network are computed. This network structure is then used in the Talon product. The machine is now trained. It does not learn further in normal operation but further training sets may be done to refine the performance or take account of changes in plate style and format.

Depending on the suitability of the neural network chosen, a new input example will produce one obvious output response. Every possible output (here for example A-Z and 0-9) may give some level of response. The objective is to ensure adequate training for the application such that, under as many conditions as possible, one clear winning solution exists for each character identified during segmentation.

Under very difficult conditions, more than one solution may produce responses of similar magnitude from the neural network. The difference between these responses will give the system a confidence level in its final choice. Each character which makes up the number plate will generate a confidence level, and multiple hits on the plate as it passes through the field of view of the camera will generate more information on which to produce an overall confidence in the single solution presented to the output plate log. This approach has proved very successful for number plate recognition. Training cannot be considered to be a perfect science since the variability of the 'real world' training set is difficult to control. The more examples of commonly occurring character distortions, which can be introduced during training, the more likely the system, will recognise further examples correctly.

A neural network approach offers the ability to capture complex relationships between pixels and between variation in font and structure of the same character on plates from many sources. This is achieved without devising complicated and possibly deficient algorithms. It also provides the ability to introduce further patterns to the set, such as the 'dash' on the Dutch plate, or to train on a completely different character set. The process for doing any new training is the same. A neural network approach captures this knowledge with no intervention by the designer. The designer's skill is deployed in implementing such networks so that they can perform their function quickly.

Illumination

For 24-hour operation, it is essential that some form of artificial illumination be employed. Using visible light cameras presents a problem in adapting camera parameters to present good contrast images of number plates over a very wide dynamic range of lighting levels. Even when an auto iris lens is employed, the level of adaptation is such that depth of focus can be seriously affected between day and night time operation. In addition, the Automatic Gain and Shutter Controls attempt to maintain the overall image within acceptable limits but the number plate that is of primary importance may suffer. An alternative to using visible lighting is to use infrared floodlighting.

This offers a more covert system at night but no other significant advantages, especially as most cameras have a poorer sensitivity in the near infrared. Restricting the camera sensitivity to a narrow band of wavelengths can provide a useful advantage. For example, infrared illumination combined with a monochrome camera that is fitted with a narrow band optical IR filter cuts out a large proportion of the radiation emitted by the sun or vehicle lights. The dynamic range of in-band radiation is greatly reduced and fixed aperture lenses may be used, providing known constant depth of focus.

A further improvement is applied by exploiting the retroreflective properties of most modern vehicle number plates. If the illumination is collocated with the camera, reflective plates will produce a very strong reflection directly back to the camera. The component can be up to fifteen times stronger than the energy returning from non-retroreflective surfaces.

Therefore the number plate stands out very clearly. Such images are ideal for ALPR. Solid state pulsed equivalents of floodlights provide a low power, reliable and totally covert alternative to the floodlight approach.

Appian is committed to the continued development of both the core Talon product and associated system equipment. Appian has recently added a number of new functions to the product range, including, but not limited to the following:

- a) Multinational recognition including the ability to select a set of nationalities from a larger list.
- b) Full remote access for setup, diagnostics and maintenance (including software upgrades).
- c) Integrated image capture permitting images from associated cameras to be captured, compressed, stored and transmitted as a part of a data packet including ALPR data.
- d) Alternative hardware solutions including portable and "briefcase" sized equipment.

Hardware Configuration

TALON comprises an Industrial PC, together with a configurable number of Appian designed Recogniser Assemblies and includes.

- An industrial Pentium PC on a single card, together with Built In Operating System (BIOS) and standard operating system together with a Real Time Clock (RTC)
- An industry-standard back plane providing the necessary interconnections and support, and allowing the use of standard PC plug-in cards if required.
- An industrial PC Power Supply unit with integral cooling fan
- A Hard Disk, together with a Floppy Disk Drive
- An additional cooling fan with replaceable filter for the Recogniser Assemblies.
- The mechanical housing to enclose all items
- Up to seven Recogniser Assemblies

The Recogniser Assembly

The Talon Recogniser Assembly comprises a single board containing a camera multiplexer/frame grabber daughter board, a PC interface and six Digital Signal Processors - two on the main board and a further four mounted on daughter boards. The DSP's run all the software algorithms associated with plate recognition. The Recogniser Assembly will accept up to four camera inputs and is capable of processing four vehicles per second.



Figure 0-5 Talon Recogniser Assembly Fully Populated

TALON Unit

The figure below shows the 19" rack or desktop version of Talon, showing 4 recogniser assemblies on the left-hand side the PC card in the centre and the hard drive, power supply, and other standard Industrial PC chassis items on the right.

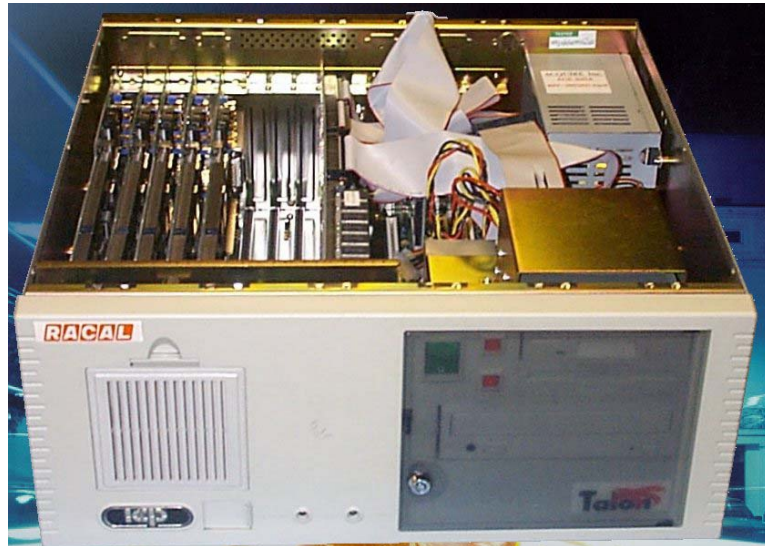


Figure 0-6 Talon 19" Rack Mount Or Desktop Unit

TALON ANPR Rack

The figure below shows a 19" rack configuration. The rack comprises 7 Plate Recognition units (containing 6 Recogniser Assemblies), and a 100Mb/s Ethernet switch.

Each cabinet is capable of handling a maximum of 140 lanes.



Figure 0-7 Typical Talon 19" Rack

Software Configuration

The software is held in three forms: PC software, DSP software and microcontroller software.

PC Software

The software performs the following main functions: -

- Basic housekeeping for the TALON, disk control, monitor and keyboard interface, output capability via ethernet, RS232 or the parallel port, provision of the time and date stamp and supervisory control over the Recogniser assemblies.
- Context checking of the recognised string of characters as reported by the DSP, to verify it falls into the syntax rules governing the appropriate nationality or style of plate.
- Post Processing, to ensure that only one VRN is output for each plate recognised, even though there may be a number of possible plate numbers corresponding to different grabbed frame from the camera input.

DSP Software

This software performs the following functions on receipt of an image from the Frame Grabber:

- Checks for presence of a valid Number Plate, by filtering each image for the spatial frequencies known to be characteristic of Number Plates.
- Isolates and extracts the section of the image in which the Number Plate has been found.
- Binarises that patch from a preset greyscale threshold.
- Performs derotation and deskewing of the binarised patch.
- Segments that binary image patch into areas likely to contain characters.
- Presents the segmented characters to a Neural Network, which performs the actual character recognition.
- The recognised characters have a score which represents the confidence with which the Neural Networks have recognised them; if this score is below preset thresholds, the binarising process is repeated using additional thresholds.
- Generates the most likely character matches, together with a single confidence level representing a combination of individual character confidence levels.
- Outputs the recognised characters to the PC for context checking, Post Processing and eventual output.
- Signals to the microcontroller that it is available for the next image.

Micro controller Software

This software controls the multiplexer to allocate camera sources to the Frame Grabber and allocates images from the Frame Grabber to a free DSP by maintaining a register of available DSP devices. The micro controller performs initialisation of the DSPs and frame grabber. It performs built in test (BIT) functions to check the operation of the DSPs and check that a camera source is connected.

Talon™ Windows 2000 Software description

Ease Of User Operation

Talon V6 provides for several levels of interaction tied to the Windows™ 2000 logon accounts.

At one end of the scale, the entire system is hidden from the end user, and the functionality is started, stopped, and the plate string and other data utilised by the Application Software - particularly Appian's Talon™ Application products, covering Access Control, Car Parking, and Image Grabbing. It is envisaged that this Application Software provides the whole user interaction with the system, once Talon™ has been configured by the installer.

For systems where some degree of end-user configuration is required, perhaps by local IT staff, there is an option of providing the basic Windows™-style user interface as shown below.

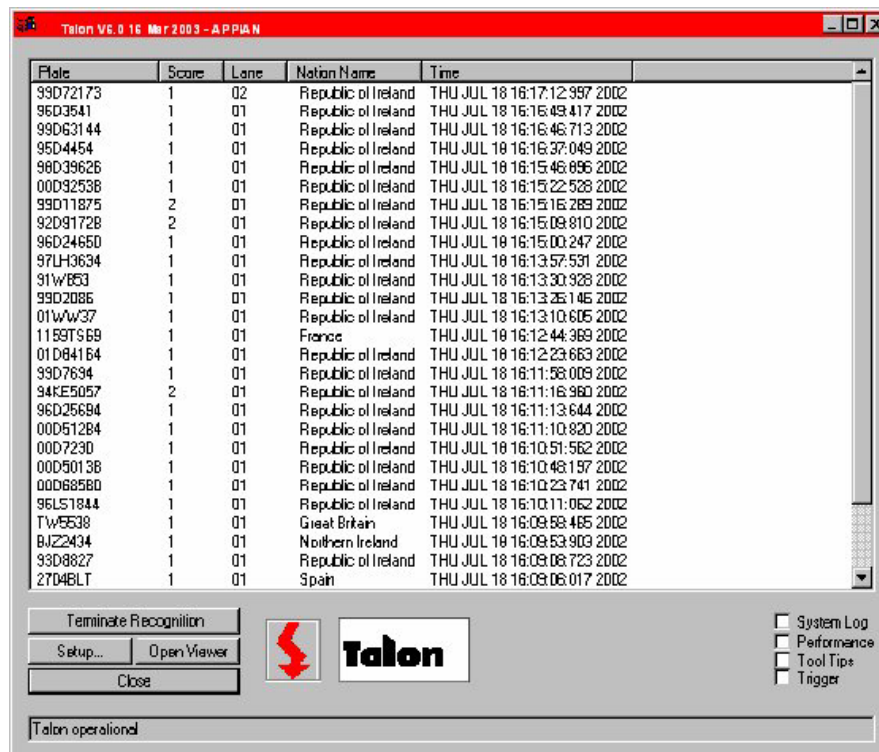


Figure 0-1 Talon V6 Normal Operation

This particular screen, the content of which is configurable, shows recognised plate string, confidence score, the lane from which this result was received, and the time and date of the grabbed frame; in addition the filename of the plate patch associated with the best recognition is shown. Appian or OEM Application Software products can use this information to show the image of the latest plate together with the recognition result for instant visual confirmation of correct read and provide the end-user operational interface.

The user interface also has associated with it a series of property sheets, a subset of those shown in Fig 3-2.

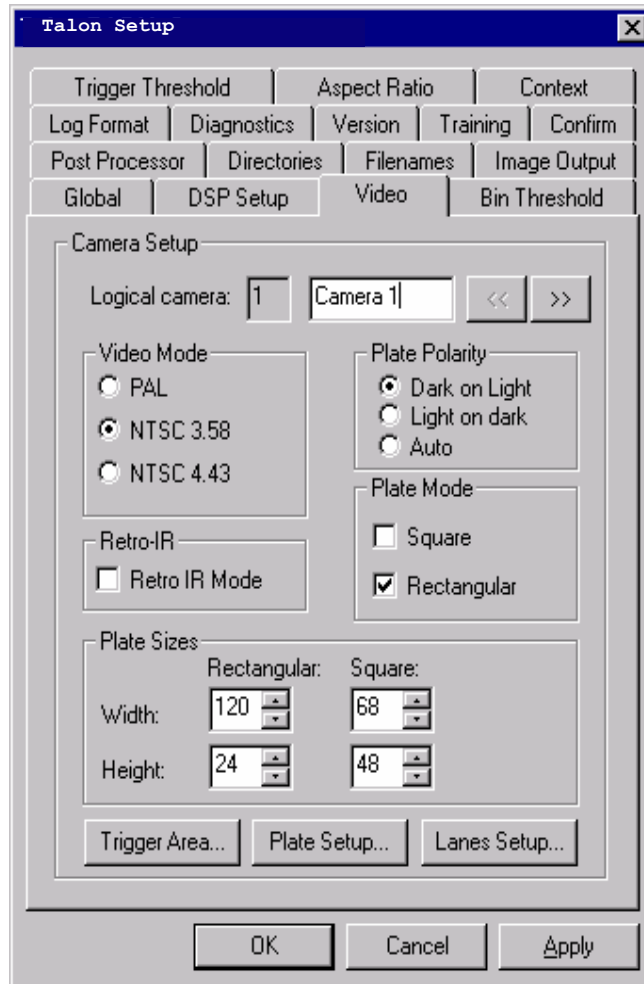


Figure 0-2 Property Sheets

Finally for System Integrator or Distributor use, the 2000 Administrator logon provides a similar user interface, and more comprehensive property sheets, as shown in Fig 3-2, with access to the diagnostic tools. Tool tips and help files are available to assist operator and installer initial familiarisation.

Ease of Setup

Setup Wizard

Automatically for first use, and by user choice at any time thereafter, a wizard leads the user or his configuration personnel through the required steps to initiate operation of the numbered facilities. This covers camera type, connection and setup, required multinationality, country or state plate recognition, external or internal trigger parameters (with visibility of timing and success), and lane setup.

Each lane or camera can have an associated user-defined text string for ease of reference (e.g. North Forbes Blvd, car park entry lane 1). Within this wizard, video from the connected cameras is presented in near-real-time, allowing confirmation of field-of-view, alignment and focus without the need for a separate video monitor, and also from within the wizard an autoseup program can be launched.

Trigger Setup Aids

At this stage in the wizard, which addresses triggering, the user can switch between:

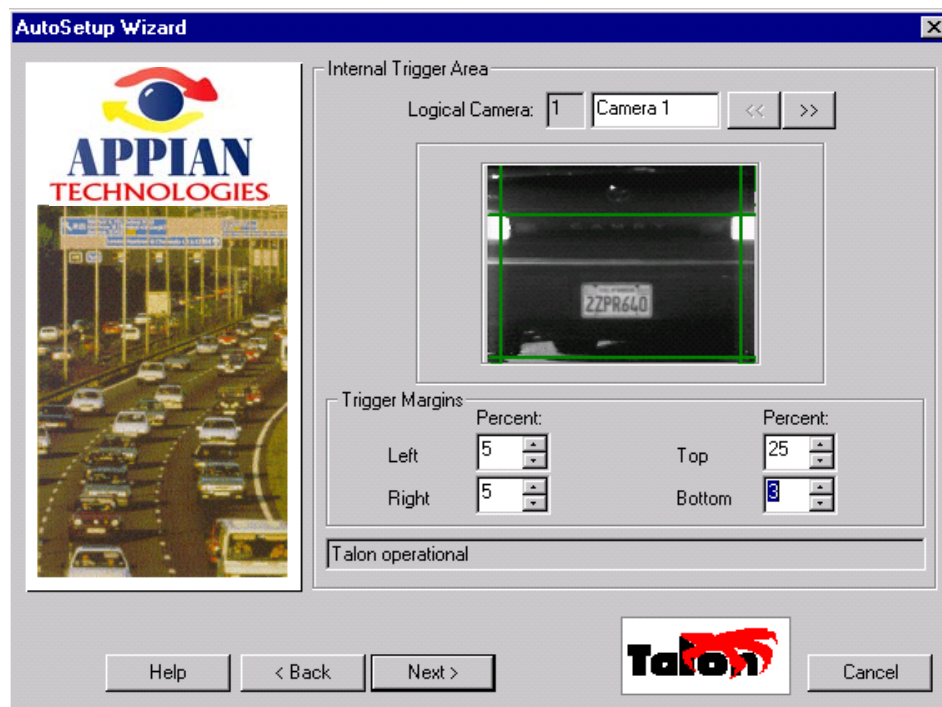


Figure 0-3 Trigger Window

Multinationality

The wizard allows selection of the country or state or group of countries/states for which plate recognition is required, from the numbered selection, this being determined at the time of ordering the equipment.

Within this selection the weighting or probability of each individual state can be set, which assists the context checker in deciding between candidate states and in choosing between candidate characters if recognition confidence is low.

AutoSetup

The AutoSetup function is launched from within the wizard and depending on the expected deployment, the routine can be set to capture a number of video images from each camera (or to run for a preset time if more appropriate), see Fig 3-5.

From these images the software builds up a statistical model of plate location within the camera field-of-view, size, rotation, and skew. This process can be used on live systems, with real traffic, or on systems in the process of commissioning, when sample vehicles can be placed on the expected target path for preliminary setup. The data from these are used to recommend Talon™ setup parameters which can be accepted into Talon™ setup (initially recommended) or amended as required.

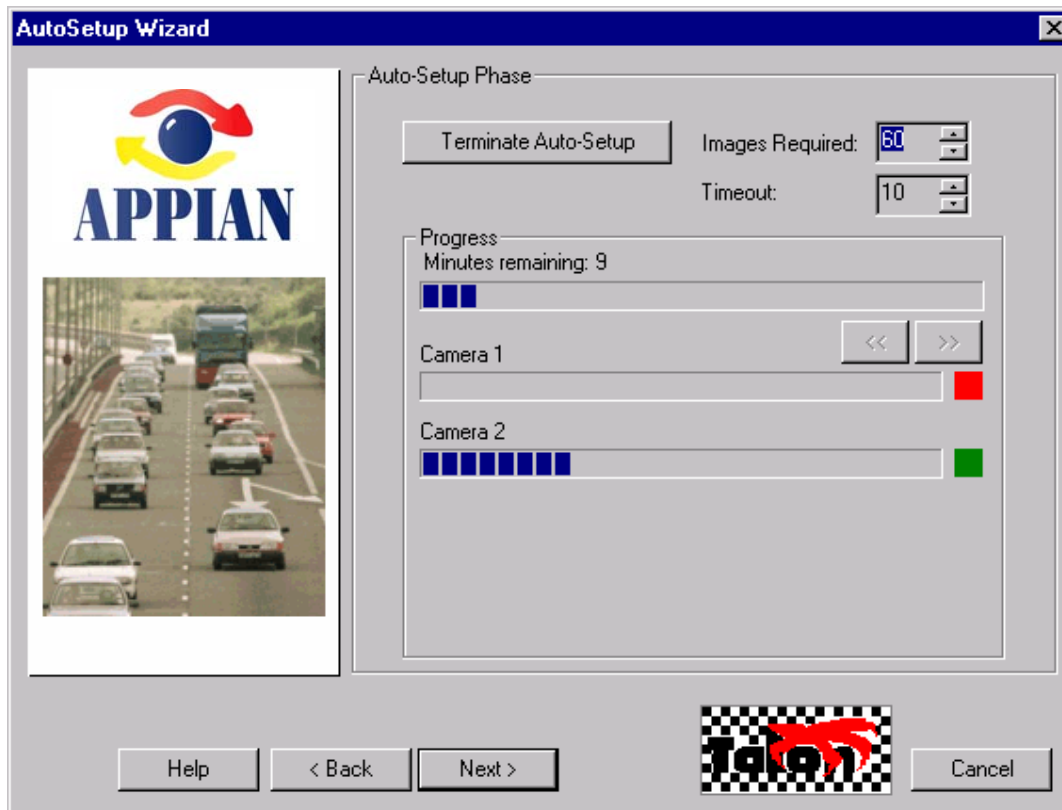


Figure 0-4 AutoSetup In Operation

- a view of the video from the required camera, with overlaid trigger area boundaries, adjustable from within that window (e.g. optimise the area through which the vehicle tracks pass, for best trigger performance), as shown in Fig 3-3, and
- A timeline view of the trigger operation as shown in Fig 3-4.

The timeline view displays the internal triggers, derived by Talon™ from the video, i.e. identifies those video frames in which Talon™ has detected a plate-like object, in the following forms:

- a green line represent a trigger, but no subsequent plate string (i.e. a false trigger);
- red lines represent a trigger with subsequent successful plate string.

Trigger parameters are presented on the same screen and one can thus tune these for minimum green lines, whilst verifying red lines present for each valid plate. The timebase can be varied to suit requirements, and the same display can be used with external triggers. In this case all external trigger parameters are also presented on the same screen, and blue lines are used to indicate an external trigger has been received but this did not result in an internal trigger.

Both of these views are available for any of the cameras in the system.

Manual Configuration

A more expert user can make use of all the tools and property sheets described above, again via the 2000 logon account, for manual adjustment, or to amend the operating environment.

Diagnostic Tools

Viewer

The more expert user can place the software into “Viewer Mode”, in which the following facilities are available:

Video Viewer

The video viewer can be selected and shows images from the selected camera in near-real-time to confirm connection, activity and alignment, although recognition performance is halted for the duration of the display.

Verbose Viewer

The Verbose Viewer halts normal operation and allows isolation of each stage of the recognition process, from triggering and platefinding through segmentation and onto final neural net output on that frame, as an aid to understanding how the current setup is performing, and where improvement can be obtained.

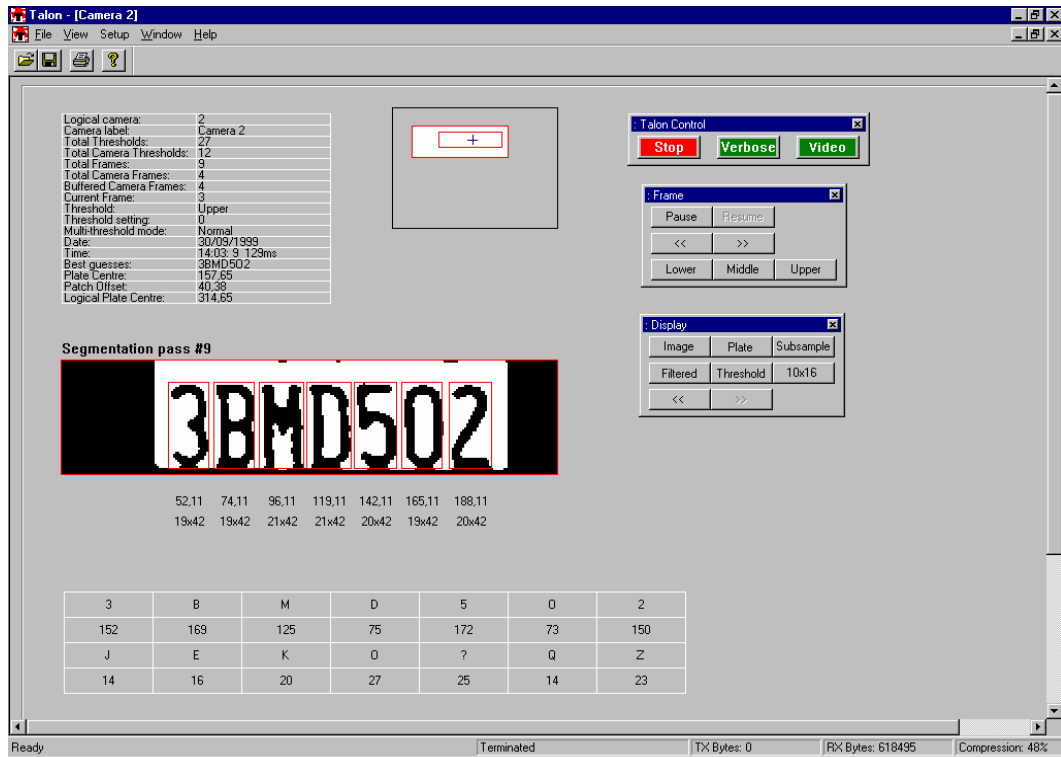


Figure 0-5 Verbose Final Display

Each stage is stored and the results on up to 100 numbered images can be examined and can be accessed forwards or backwards, and the same stage on different images compared.

The entire file can be saved for later or offline analysis or transmission to Appian for diagnostic support. The Talon™ application also serves as a viewer and files from other installations can be examined using the same PRU.

The Verbose Viewer window can be left on screen whilst the property pages are accessed and the results on performance of any changes to these properties can be seen directly on the viewer.

Error Log

The software maintains running files of errors and events, which can be viewed without affecting recognition performance.

Performance Window

If the 2000 logon utilised is a Super User or higher the timeview described above can be displayed by a logon at any time.

Performance

With standard retro-reflective black-on-white plates the previous Talon™ performance was high, but significant improvements have been made. The opportunity has been taken to improve a number of internal processes, such as thread management, context checker and post processing algorithms, and following a recognition failure analysis, the number of spurious responses have been reduced and number of correct hits increased. In conjunction with the much easier setup process the end result is overall better performance than previously available.

As previously, with complex, coloured or partly reflective plates, recognition is dependent on the correct choice of camera / illuminator technology. However recent advances in these fields provide improved images. In particular, infra-red camera and illuminators are now available in different wavelengths, which provide improved contrast on a range of plate styles, and improved control of those cameras provides better dynamic range of operation.