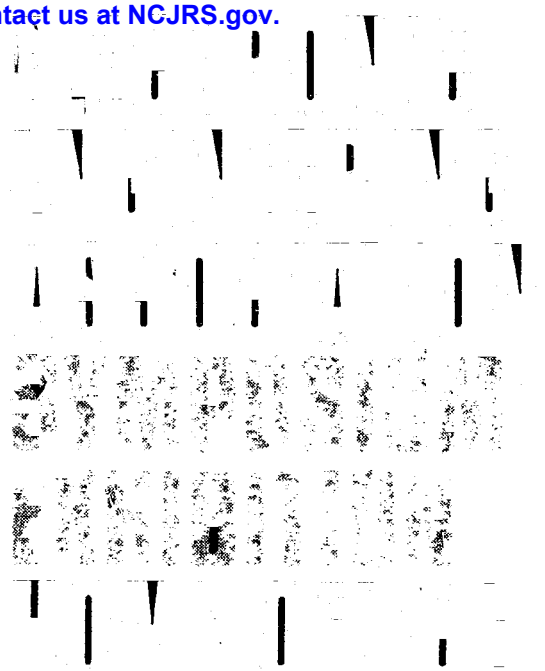

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Session 5

The Application of Electronic Technology to Crime Detection and Prevention

Chairman: Rupert Ashworth

SYMPOSIUM OF TECHNOLOGY IN MODERN POLICE FORCES

Session 5

Police Requirements and Experience in the Application of Electronic Technology to Crime Detection and Prevention

Percy Walton

Deputy Assistant Commissioner
Metropolitan Police

POLICE REQUIREMENTS AND EXPERIENCE IN THE APPLICATION OF ELECTRONIC TECHNOLOGY TO CRIME DETECTION AND PREVENTION

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It is not so very long ago when the technical aids available to a Police Officer were:

A whistle,
Pieces of whalebone, and
A reel of black cotton.

The whistle was his means of communication whilst the whalebone and cotton were his intruder alarms or perimeter security devices. Most if not all present at this conference are familiar with the whistle but may I venture to suggest that some of us here even recall the whalebone and cotton.

Over the past 25 years, and in particular during the last decade, it has been shown that traditional Police methods are so labour intensive as to need radical change. The major motivation for implementing such change has probably been our ability to use developing technology to streamline Police operations preferably in a way that ensures our over-stretched manpower can be left to concentrate on those areas where the human touch is most needed.

In order to keep the peace and to arrest the wrong doers, it has always been necessary for a Police Officer to see and hear well, to communicate efficiently, to respond to cries for help and thereby to effect arrests.

Advances in technology have certainly provided aids which enable Police Officers to extend their senses beyond their natural limits but such advances generally are also available to the criminal. It is essential therefore that the Police Service keeps abreast of technological developments to ensure that criminals do not get the upper hand.

I would strongly assert, however, that keeping abreast is not enough in these days of rapidly advancing technology. We, the Police, need to influence those advances in order that they may be directed towards and moulded into the true needs of the Service. In short we must spell out our operational requirements and develop a clear and meaningful dialogue with industry, otherwise the manufacturers will be unaware of our precise needs or may misinterpret them.

Is is my personal view that the Police Service has not been the best of agencies in identifying and making its operational requirement known. In consequence we have been inclined to settle for something off the shelf or the peg instead of a tailor made suit.

The end product has told its own story when, after limited usuage, shortcomings are identified and modifications essential.

There have, of course, been very successful projects where research programmes have produced police equipment for general use, but in the more specialist areas it is better perhaps to recognise that equipment for commercial, military, industrial or medical use may with only slight modification be useable in the Police environment. In the medical field for instance the uses of fibreoptics, thermography, X-ray technology and video display enhancement have all been adapted for use in Police circles.

In order to take advantage of current work for apparently other users it is essential therefore that communications take place at the earliest stage of development, and that the Police/Industry channel is open at every level.

The collective employment and close co-operation of Police Officers, engineers, technicians, scientists and researchers within the structure of my own Force at New Scotland Yard has gone a long way towards overcoming the type of difficulties I have outlined.

The collective work of Police Officers and scientists within the framework of the Home Office Police Scientific Development Branch has resulted in earlier identification of Police technical needs and praiseworthy endeavours to meet those needs by experimentation and close liaison with Industry.

Let us then look at our needs in the light of experience.

The true but unrealistic Police requirements in crime prevention and particularly the area of surveillance are for the supply of equipment which assists in the enforcement of the law of the land by ignoring the laws of physics. We require very fast, high-powered lenses which will fit in a pocket, miniature batteries with long lifetimes and high current capability, and narrow band communications systems for carrying wide band information. We can't have them - so in reality the investigating officer must be capable of getting the best operational results whilst keeping within the constraints of scientific rules.

Crime and surveillance operations are of infinite variety and it soon becomes apparent that singular items of equipment seldom satisfy all the variations of operational use to which they need to be put. Equipment needs to be created in a way which gives the operator the choice of what is operationally acceptable within the limits of available technology.

Our answer has been to either ask for equipment which can be easily varied in such details as supply voltage, operating life, effective power and range or to create families of similar equipment where the number of variations exceeds a practical level.

SURVEILLANCE

Surveillance in the criminal field requires picture or film acquisition at ranges between 3 feet and 500 yards, and here is a good example of the impossibility of producing one piece of equipment which will satisfy all needs. On the electronic side, therefore, we have the requirement for a family of

T.V. systems which will cope with all the variations in light, distance, power requirements and size which will enable us to make the choice between seeking visual information from the inside of a siege situation, such as Spaghetti House, or keep automatic 24 hour surveillance on the exterior of a target at long range, irrespective of changes in light from bright sunlight to darkness and fog. Typical cases are a train hijacking as recently occurred in Holland or a hijacked aircraft situation where firepower prevents close approaches by the Police or even seeking that lone prowler in darkness or bad weather at long range.

SEARCH AND DETECTION

Search and detection requirements for Police are as varied again as those of surveillance. We would hope to discover buried bodies, without major excavation, and to quickly find explosives, drugs, arms and ammunition in all the varied hiding places without major operations or damage to property. Searches for such items in large ships, aircraft, container vehicles, including refrigerated vehicles, or even concealed on the person of numerous people passing through ports, attending football matches or public demnostrations must be executed quickly, efficiently and without heavy demands on manpower. Many of these needs have been clearly identified in our attempts to quell the traffic of illicit arms/ammunition and explosives into the U.K. during the fairly recent I.R.A. bombing campaign.

We would similarly hope to search and find living human beings and/or animals in places where they should or should not be, e.g. to find guerillas or escaped fugitives in rural areas or the disposition of hostages and/or hostage takers in a place of siege. Such aids would have helped to locate the murderer who camped out in a wood a few years ago after he had been involved in the murder of three Police Officers.

Thermal imaging equipment was used at the Balcombe Street siege in an attempt to establish how many people were in the flat, and where they were. At that time we were uncertain as to how many terrorists were involved. In fact we did not know for some time that they had barricaded themselves into one room as opposed to occupying the entire flat. Such information, you will appreciate, would have been vital in determining Police strategy and the deployment of our Officers.

Bearing in mind all the Police requirements, I have identified without doubt the major problem we present to the manufacturers is the specificity of that which is required and the varied and difficult terrains in which search and detection systems must be successful even in the hands of unskilled personnel.

TRANSMISSION

With respect to the transmission of information, it is necessary in a number of situations, such as intruder detection and unmanned surveillance, for the acquired information to be transmitted to users who are not at the acquisition scene.

The problem is therefore one of communication and the situation where either narrow band and/or wide band information must be passed from one place to another without there being the ability to install fixed or permanent communications systems.

In hijackings and siege situations, the relaying of information from the parked aircraft, the location of the siege or the family home in cases of kidnappings is certainly a problem. When the BAC III aircraft was hijacked at London Airport reliance was placed on radio communication between the plane and the airport control tower. Unfortunately it was monitored by the media and relayed live on T.V. and radio to the public at large - a totally undesirable situation.

At the Spaghetti House siege, we were able to relay pictures and sound obtained from the siege room by closed circuit T.V. to command, the Incident Room and our marksmen. At the same time we were able to record that information on audio and video tape. Our lines of communication were all within a very confined area under Police control and there was no monitoring by other agencies, although some attempts were made. At the Balcombe Street siege the situation was a little different - the control for our marksment and the negotiators room were just across the street from the site of the siege. Forward control was a little further away whilst the Incident Room and Command were about ¼ mile away, near to Marylebone Station. As the operation progressed, it was necessary to relay audio and visual information to each of these points, via a monitoring and distribution centre about 25 yeards from the scene. Each need was dealt with separately and although all needs were ably satisfied the cabling was considerable with a mass of tangled cables in the forward posts and into the distribution centre. We require quicker methods and simpler means of meeting these needs. Micro-wave links would appear to be a possible answer in both the siege and hijack situations. There is also of course the inherent need in such situations to ensure secure speech in these vital areas of the operation. A similar requirement was identified in the case of the kidnapped Greek Cypriot girl in North London in late 1975. On that occasion all the vital messages from the kidnappers were received on the telephone installed in the family home and we had therefore to keep that line open. The situation of the house was such that it would have been highly inadvisable and would have possibly betrayed Police activity at the home etc. to have allowed G.P.O. engineers to install another telephone line. Swift communications with Forward H.Q. and Command were essential and the use of normal Police radio links were totally inadvisable. The perpetrators had threatened the life of the hostage if Police were informed. A blackout on information had been imposed both within and without the Police Service except on a need to know basis. This is another example that clearly indicates Police requirements in the transmission of information in respect of which I am certain subsequent speakers will be able to make constructive suggestions as to their solution. I believe the technology to find the best balance between time, band width and information content is becoming available to the operational side. There is certainly a great deal of fruitful work to be done in this sphere.

TRACKING

Here again there is no single solution to operational requirements, and at this stage it is a matter of policy in my Force that where life is at risk in a kidnapping situation, there will be no attempt to 'bug' money to be passed to the perpetrators but in cases of extortion without life being at stake it is reasonably safe to do so. In the case of tracking vehicles or persons the choice must still rest with the investigating officer as to the size against range against life configuration which will best suit his purpose. An important consideration is the risk of discovery according to the case in hand.

As far as the readout to such a system is concerned, it is obvious that reliance on a specially equipped vehicle for this purpose could be undermined by vehicle breakdown or traffic conditions. Steps have had to be taken to ensure that the flexibility in transmission systems was matched by complementary and fail safe readout techniques, such as fixed site or portable sites (if necessary in series) to take over in the case of primary failure or to redirect the original tracker into the range of the car or person under surveillance.

CONCLUSION

International co-operation and the freer flow of information on technology which has marked the last ten years has disclosed, probably not surprisingly, that the same problems exist with most if not all law enforcement agencies throughout the civilized world. We have come a long way from whalebone and cotton but the surveillance field is one where great opportunities still exist for the development of all forms of equipment from the simple to the highly sophisticated, and any technical solutions to one country's Police requirements will automatically provide them for others. This symposium, therefore, has given us an opportunity to start the sort of dialogue which can only be of the greatest assistance to us all. I am quite sure that the broad communication established here can be continued beyond the confines of this symposium and I can state that we on our part will help as much as possible to define specific Police requirements in this area in a way which will produce not only short term operational solutions but the possibilities of commercially viable products in the marketplaces of the world.

SESSION 5 - THE APPLICATION OF ELECTRONIC TECHNOLOGY TO CRIME DETECTION AND PREVENTION

EXPERIMENTAL TECHNIQUES

by Alan Rapsey, Deputy Director, Police Scientific Development Branch, Home Office

INTRODUCTION

The Home Office research establishment at Sandridge, which is part of the Police Scientific Development Branch, carries out research and development on new equipment for the police. The subjects for our research programme are suggested directly by police forces, the Police Research Services unit, a group of policemen seconded to the Home Office to assist in research, or by the research staff themselves. The expected results of each project are usefully evaluated quantitatively to ensure that work is carried out only on equipment which would be most useful to police forces.

I shall now describe the current state of development of electronic equipment for the police.

IMAGE INTENSIFIER

Electronic light amplifiers (called image intensifiers) have been developed for military use at night and these have been adapted for police use. The police requirement was for equipment to enable observation to be kept in a wide variety of environments from very dark rural situations to dark areas in otherwise well-lit urban sites, and to enable good quality photographs to be taken in all these situations.

Two types of image intensifier are (1) the cascade tube, with a light gain of approximately 100,000 which is very good for evenly illuminated scenes and (2) the channel-plate tube which has slightly less gain, but is good for unevenly illuminated scenes. Clearly both kinds are necessary for police use.

A modular kit has been designed which enables the police user to select the appropriate intensifier tube, lenses and camera adaptors to suit his particular purpose. This can be seen in the exhibition.

THERMAL IMAGING

If we look at scenes with an image converter which is sensitive only to long wavelength infra-red, in the 3-5 micron region, some very interesting and useful effects may be observed. One can detect which rooms in a house are occupied, the relative times of arrival of cars in a car park by looking at their tyres or their engines.

Another interesting effect can be seen when looking at, say, a wood at night time where with an image intensifier we see just trees but with a thermal imager we can see clearly the presence of a hot object - a man hidden in the trees. Such equipment can also extend the range of direction of objects in poor atmospheric conditions.

Thermal imaging equipment has been available for some time but most of it is either very bulky, requires liquid nitrogen cooling or is prohibitively expensive. A new low-cost portable thermal imager has been designed which it is hoped will be very useful to police. This is now undergoing field trials and will shortly be available commercially.

METAL DETECTORS

Police want to be able to detect both ferrous objects, such as guns, knives, etc., and non-ferrous objects, such as gold, silver (stolen property), cartridge cases, etc. The wide range of sizes of objects and the ranges at which they must be detected make the police requirement even more stringent than the corresponding military one. In response to this three types of detectors have been designed.

(1) A general purpose instrument which will detect all metals by inducing eddy currents into the object and measuring the magnetic effects produced by these currents.

(2) A magnetic gradiometer which detects only ferrous objects by sensing the local changes which they cause in the Earth's magnetic field.

(3) A detector which can be switched to detect either ferrous or non-ferrous materials and to ignore the other type. This can be useful in special circumstances such as searching for a gun on the verges of a major wood where there will be large numbers of pieces of aluminium foil from cigarette packets.

Excellent models of the first two types are available while the third type is under development.

VEHICLE TRACKING EQUIPMENT

Although much work has been done on radio direction finding, none of it was easily applicable to following a small transmitter attached to a motor vehicle from another vehicle at ranges of at least a mile. There was equipment available commercially from overseas but this gave a very poor performance.

Much work was done to determine the best frequencies to use for all types of terrain, from open country to densely built-up towns, and to consider equipment which was easy to use. The resulting system gives ranges of up to 7 miles in open country and 1 mile in the centre of London. It can easily be transferred from one vehicle to another and the display is very clear and easy to follow. It is on show in the exhibition.

TELEVISION

For surveillance purposes the cameras should be as small and inconspicuous as possible, sensitive enough to view the scene under a range of lighting conditions and yet still cheap enough to enable their use in numbers adequate to make all points clearly visible to an observer. Evaluation of British made small cameras show that these are now very suitable to police requirements.

For television observation under very poor lighting conditions the intensifier image isocon tube has proved to be the very best obtainable giving good pictures down to illumination levels of 10-3 lux. Here the price precludes large scale use but it is acceptable under special circumstances.

For many purposes simpler and cheaper cameras are adequate and there is now a range of silicon target tubes and without image intensification which perform very well.

Closed circuit television systems are to be preferred for surveillance purposes but where the laying of cables is impractical, much can be accomplished with small microwave links of the kind shown in the exhibition. These are easily erected if there is a clear line of sight between them.

For occasions where there is no clear path we have developed some new equipment to enable short and medium distances to be covered by radio transmission.

Bandwidth considerations have made it impossible for us to obtain a frequency allocation in the VHF or UHF regions and experiments have been carried out at low microwave frequencies to determine their suitability for this purpose. These were successful and equipment has now been produced which gives good performance of ranges of up to 300 metres for a low power version and 24 km for a higher power version.

MOVEMENT DETECTORS

One of a series of useful devices for the detection of movements has been produced using pyroelectric detectors. These detect changes in the thermal radiation falling on them and can be used with a telescope attachment to detect movement of persons at 100 metre range quite cheaply.

Other types of detectors use infra-red beams and ground vibrations to detect movement. Ruggedised equipment is available using these techniques which can be erected rapidly in a wide variety of environments.

PERIMETER ALARM SYSTEMS

These are the responsibility of the Scientific Advisory Branch of the Home Office. Following considerable experience of earlier systems, an operational requirement was prepared which resulted in the sponsoring of several interesting development projects.

The object is to detect the entry of a human body into a designated zone, the shape of which will vary with the type of perimeter barrier, but is perhaps best described as a sterile zone between two fences approximately 7 metres apart. The perimeter is divided into 50 metre sections to conform with standard UK prison practice.

It is of great importance that the false alarm rate due to all causes, for example weather, road traffic, proximity of birds, electricity supply variations, electrical disturbance, etc., does not exceed one per day. The systems do not provide mechanical assistance to an intruder and are immune from deliberate interference as far as possible. The target cost for a practical perimeter alarm is less than £20 per metre for a 600 metre perimeter.

There are now several excellent systems which may be seen in the exhibition.

I trust that this rapid trip through the fertile field of police equipment development will provide a useful introduction to the EEA paper.

SESSION 5 - THE APPLICATION OF ELECTRONIC TECHNOLOGY TO CRIME DETECTION AND PREVENTION

INDUSTRIAL POSSIBILITIES

by Dr. Roy Hayes, Electronic Engineering Association

INTRODUCTION

The Police and Home Office papers set the background for this EEA paper to describe specific equipments which can be provided by British Industry to meet the needs of crime detection and prevention. To provide a link between the varied equipments I have used as a theme the provision of electronic aids to Observation, Detection and Search. The first product to be described is a versatile image intensifier observation system.

IMAGE INTENSIFIERS

The modular image intensifier system is arranged so that commercial photographic lenses, such as NIKON, PENTAX or CANNON, of different characteristics may be attached with special adaptors to the intensifier tube. A specific mirror lens of long focal length (170 mm) and wide aperture (f 1.5) has been specially designed for the system.

For normal surveillance a biocular magnifier eyepiece is used. It enables the intensified image to be viewed with both eyes at a distance of between 50 and 250 mm or two people to view with one looking over the other's shoulder. A monocular eyepiece is also provided as this prevents the viewer being seen by stray light from the intensifier tube.

The camera exposure meter system is used normally to determine exposure times. The various assemblies can be hand-held, mounted on tripods or used with commercial pistol grips or rifle butts.

The art in the design of such equipment and putting them into a system is the achievement of an adequate balance of tube performance with surveillance and camera requirements. The modular system enables this to be achieved.

THERMAL IMAGERS

A thermal viewer does not make use of reflected sun or starlight but uses the invisible, long wavelength, infra-red radiation emitted from warm bodies.

An advantage of the long wavelength infra-red radiation is that it can extend the detection of objects in conditions of unfavourable atmosphere such as mist, fog, smoke, etc.

To produce a thermal image the received radiation is focussed by an infra-red optical system on to a mechanical scanner. Whilst the optical system can use mirrors, in general, lenses are preferred. The scanner is necessary because, at present, we do not have the capability to fully electronically process a complete picture. From the scanner the radiation is detected, amplified and converted to visible radiation by means of semiconductor light emitting diodes. The scanner now reverses the previous process and reconstructs the visible light into a scene which is viewed by an eyepiece. The impression gained by the viewer is that he is seeing the scene directly.

To render infra-red radiation visible a special form of electronic detector is required which, unfortunately, requires cooling to very low temperatures. In the 3 to 5 micron infra-red band selected by one of the commerial viewers,

the detector can be cooled electronically thus eliminating the need for special cooling fluids or mechanical refrigeration. This enables a compact hand-held equipment to be produced.

However, to get the best possible sensitivity a detector cooled by liquid nitrogen is needed. Such a system is available which can be adapted for use in the portable and hand-held modes.

TELEVISION CAMERAS

Television is a well known technique but is still provides a cheap and effective means of remote observation. A wide range of cameras are available. Two that have proved useful are an image isocon for low light use and a small vidicon which gives good performance but is easily concealed.

MICROWAVE LINKS

For connecting observation systems back to a remote control centre, microwave communication links have proved easy to set up and reliable in use. For covert surveillance small links with special aerials that can be easily disguised are available. These aerials have the appearance of car interior mirrors, wing mirrors, fog or reversing lamps.

POINT VISIBILITY MONITOR

Observation devices have their performance limited by adverse weather conditions, particularly fog. A device has been produced for the Home Office to measure the visibility on motorways where it has been very successful. This simple and robust point visibility meter may therefore have a further application in assessing equipment potential when used in conjunction with remote observation devices.

Moving on to Detection devices we have a wide range of physical effects that can be monitored to detect intruders. The first of these to be described is another optical device.

OPTICAL MAN DETECTOR

The thermal imagers previously described require cooled detectors. To detect movement using infra-red radiation uncooled detectors can be used. A range of suitable robust pyroelectric detectors, which can withstand high ambient temperatures, are now available.

Using these detectors an equipment has been developed and supplied to the Home Office which can act as a thermal sentry detecting the intrusion of a human-being at a maximum range of 100 metres.

INTRUSION DETECTION SYSTEMS

A range of portable magnetic sensors, which are suitable for interior and exterior use, have been developed. Although the detectors can be used on their own it is preferable to use them in pairs as by this means the background can be balanced out and this increases their operating range. For example, they can detect motor vehicles up to a distance of 10 to 20 metres. They are self-contained, have a low battery consumption, are portable and readily emplaced. If required, a short-range radio transmitter and receiver is also available to complete the sensor link. A standard digital interface is used enabling the radio link to be used with any other short-range sensor sub-system, such as seismic and active and passive infra-red devices.

PERIMETER ALARM SYSTEMS

Two new systems have been developed to meet the Home Office specification for prison perimeter alarm systems. The first is called Method 5 and detects changing reflections on a transmission line sensor, whose surroundings must be such that changing reflections can be caused only by intruders. Signal processing is employed to eliminate fixed reflections which are received from the sensor surroundings and also to reject interference. The sensing lines may be mounted so that they are using real earth or a heavy conductor as an earth return. One equipment covers over 600 m of perimeter, with range indication every 50 m and an upright man will be detected when 2 m from one of the sensing wires. Equipments may be cascaded to cover any distance.

Two well engineered prototype equipments exist including control and display facilities and have been extensively field tested by the Home Office over the past year.

The second system is called RADCAB and this unique system employs radiating co-axial cables laid on, or just below, the ground. Radiating cables are co-axial cables whose outer sheath has been pierced to allow radio frequencies to leak out. Two cables are laid parallel to each other, one acting as a transmitter, the other feeding a special receiver. When an intruder approaches or crosses one of the cables the radio field is disturbed and an alarm is signalled.

This system, which has been sponsored by the Home Office, Scientific Advisory Branch, offers the following advantages over systems using microwave or infra-red beams:

(a) The protected zone can follow irregularities in the perimeter and terrain, it can also avoid irregularities and obstacles such as trees. It does not therefore require extensive site works before installation.

(b) The cables can be mounted horizontally or vertically. The system can therefore equally protect walls, rigid fences, buildings, as well as open ground. In the latter case it can be completely buried producing a covert system.

(c) The presence of small animals will not cause false alarms.

Whilst the cable forms a major cost in the system it can be easily installed using a mechanical digger and its operating advantages outweight this cost. However, if the total cost of installation, including site levelling, fences and installation are taken into account, the RADCAB perimeter protection system is very competitive with the added advantage of being completely hidden.

A narrow band of frequency in the VHF/UHF band is required for its operation and the detection system is designed to reject deliberate interference. Only a low power is transmitted and this does not interfere with other site equipments.

The system is installed with the two cables about 2 metres apart, giving a sensitive zone 3 metres wide by 1.5 metres high.

The system can also be supplied in a portable form where it is only necessary to run out two cables in a loop to protect a particular target. A further version designed to work over 200 metre lengths of perimeter, and called 3PS, has been developed and put into production.

Having dealt with detection systems we come to the final category of Search

aids. The first products to be described are metal detectors which have benefitted greatly from recent advances in electronic signal processing.

METAL DETECTORS

A magnetic gradiometer senses the local distortion produced in the Earth's field by a ferrous object and this anomalous field decreases with range according to an inverse square or cube law depending on the object size and distance. The field produced by an object at a known distance gives a rough guide to the size of the object. A high sensitivity instrument is not necessarily an advantage, for as well as increasing the object signal it also increases the response of other, clutter, objects and magnetic impurities in the ground.

A typical instrument has a meter display and an audio, variable pitch, output. The limiting sensitivity is sufficient to detect ferrous objects at a distance of about ten times their linear dimensions. The instrument is self-contained and uses dry batteries. Operator training is minimal, involving some interpretation of the output signals using test targets.

A more complex instrument can be provided which can indicate range and hence object size.

The active metal detector relies on inducing eddy-currents in the metal object. These eddy-currents can be induced by transmitting continuous waves or pulses. Each has advantages and disadvantages which are usually complementary.

A wide range of CW detectors is commercially available. One product has an indicator that enables it to distinguish between ferrous and non-ferrous objects. It also has coils of fixed site to enable built-in range discrimination to be achieved and displayed. The disadvantage of the CW system is that the search head had to be of fixed size and is therefore not readily adapted to suit different site and search conditions.

This limitation is overcome by the pulse system. It cannot easily distinguish between metals but since the transmit and receive coils are used independently, the head can be of any shape and can be easily changed. Very large coils can therefore be employed to search wide areas. The technique readily adapts to producing stick-like probes for searching in bushes, ditches, houses, ponds, etc.

For both systems the range is fundamentally limited because both the transmitted and received signals each reduce with a square or cube power law. Their combined law approaches an inverse sixth power, thus a hundred-fold increase in sensitivity only increases the detection range by a factor of two.

All the instruments are completely self-contained. The circuits are fully automatic in operation and include compensation for changing background levels of clutter. They can be packaged in lightweight plastic cases or supplied fully EMC screened. A waterproof underwater version of the pulsed detector is available.

RADIO LIFE LINE

This piece of radio equipment was originally developed for the Home Office for use by the Fire Fighting Services. However, it does have applications in other fields and should be of interest to police and security forces. By using a low radio frequency it enables a person to enter and search environments which so far have proved difficult to communicate through and remain in touch with his base station or to talk through to other members of a team. The environments include deep basements, tunnels, high rise buildings and ships.

A further piece of radio frequency equipment developed for the Police Scientific Development Branch is a mobile tracking system.

MOBILE TARGET TRACKER

The equipment consists of a radio transmitter which is attached to a target vehicle and a direction finding aerial and receiver systems fitted to a following or tracking vehicle. All the equipment is designed to be transportable and is readily transferred from one vehicle to another.

The transmitter is designed for fitting covertly beneath the target vehicle. It has a special aerial tuning unit to give maximum output under difficult conditions, with a typical battery life under operating conditions of 24 hours.

The receiver has a covert aerial feeding a special 4 channel receiver, located in the boot or trunk of the car. The car has usually a 3-man crew of driver, operator and navigator. The operator has a hand-held unit with which he can remotely control the receiver. It also contains a circular LED display which indicates the direction of the target relative to the operator's vehicle, together with an LED indicator of estimated target range. This gives an indication that the following distance can be increased or should be decreased. An audio channel provides information which can be interpreted to decide whether the target vehicle engine is running or not and whether the vehicle is parked or moving.

The frequency of operation is in the VHF band and the maximum range between target and tracking vehicle is 1 to 10 km, depending on whether the operation is in a dense city or an open country environment. The overall tracking accuracy is limited by multipath propagation. This does not pose any serious problems under most practical conditions due to the design of the signal processing and display system. This equipment has proved very successful and reliable in operational use.

CONCLUSION

This paper, sponsored by EEA, has covered a wide range of technologies. It has, however, shown the willingness of British Industry to devise practical solutions to operational problems and their ability to develop suitable products which can be sold to wide markets.

END