Night Vision for HVAC Duct Monitoring Bot

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Abstract – Safety and Security of life are the two most booming words in the world now. The world has emerged from being a just simple form of day to day life to being aeon of mean and daring machine. Thus the safety and comfort of the people is more important. This paper mainly deals with enhancement of our project "3G Based HVAC (Heating and Ventilating Air conditioning) Duct Monitors Robot ".This paper continuously monitors the faults in ventilation ducts by sending the video output to mobile phones. Inadequate illumination was the only factor which disturbed the video output. To overcome this difficulty we have adapted Night Vision Techniques to Our Bot. This greatly enhance the vision of the bot to a distance of 10meters.The use of visible light with the camera is not preferred because of the short distance covered by light. Many leading car manufactures have diverted their full R&D towards developing night vision technology in cars rather than going for higher torque production mainly due to the safety concerns of the humans.

Index Terms – Night Vision, HVAC, Mobile Phone.

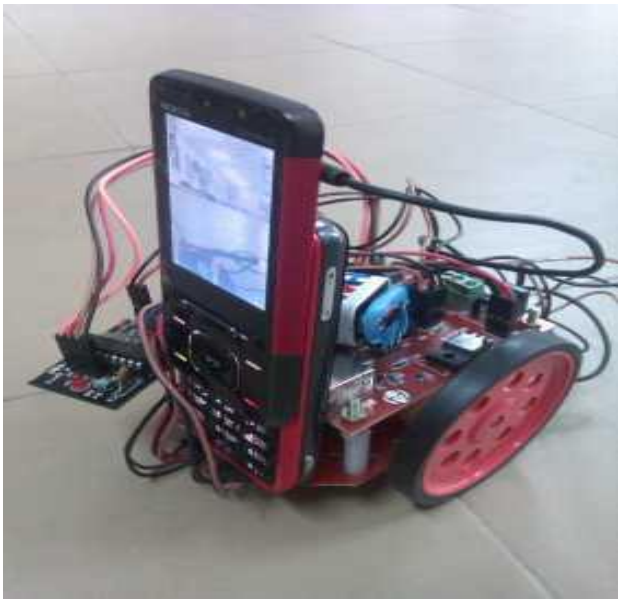
1. INTRODUCTION

Night Vision

It is a known fact that after dark it is impossible for man to see beyond a few meters in length without the correct illumination and this illumination also has its constraints. In such a case it is not possible for out bot to sense the fault in the duct. The night vision helps the bot in such cases. It makes a negative image of the image captured by the camera and illuminates the darker part thus enabling the controller to see what lies ahead in the duct causing the problem, by looking the monitor at the receiver end.

2. COMPONENTS USED

The below picture shows that bot which is sent in to the duct for monitoring. The bot also has a pair of infrared LED'S sent the IR rays which on reflected by any object is captured by the camera. The camera sends the video output to the bot controller. Our future plans are to use a dual camera system so that the distance of any object from the left corner and the right corners can be calculated so as to give a more clear perspective of the object lying ahead and make a more scrutinized judgment of the duct.



The various sensors used in this whole drive system are

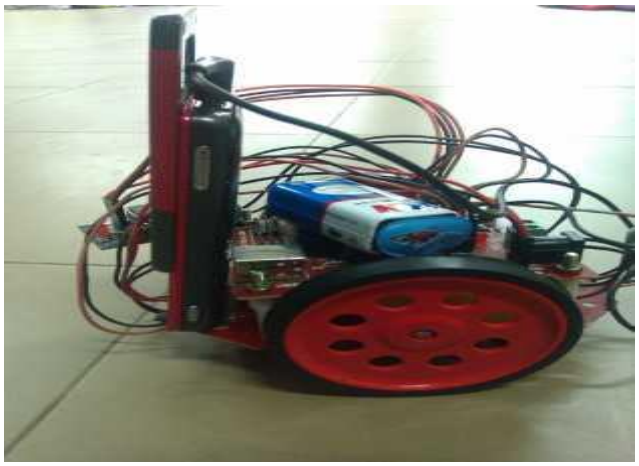
- Daylight sensors
- Night Vision Sensor

2.1. Daylight Sensors

The daylight sensors are used to detect the amount of illumination that is present outside and this system by itself determines the minimum distance that the driver is able to view. Thus the night sensors provide the assistance in giving extra illumination and the corresponding output on the graphical monitor.

2.2. Night Vision Sensor

The sensor provides a standard colour image during daylight hours and when the natural light levels falls below a pre-determined Lux level, the sensor automatically switches to black and white night vision mode. The dual mode night vision capability is useful in driver assistance and safety application.



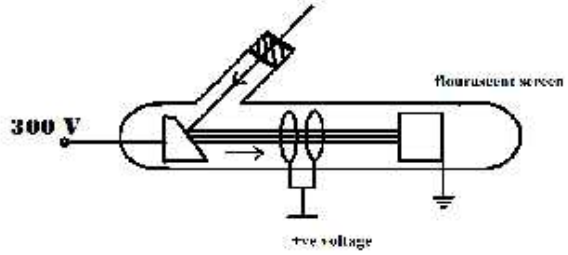
3. PROPOSED TECHNOLOGY

Night vision comes into two flavours: Near infrared (NIR) and far infrared (FIR).The near infrared technology detects the portion of the IR band nearest to visible light. But, the near IR detector needs an assist. Special bulbs must be mounted so that the sensing element senses the reflected IR rays to process the image. The infrared reflection of objects is captured and converted to a digital signal by a Charge Coupled Device (CCD).The digital signal from the CCD is routed to the image processor that translates it into a format that can be viewed in a black and white display .The far infrared technology detects energy farther up the infrared band that is emitted by objects as heat. This far IR night vision is also called passive because no special light source is required. The special camera these system use-essentially a phased array of IR detector elements analogous to pixels in an ordinary digital camera-creates a temperature pattern called a thermogram, which is refreshed 30 times a second. The heat from a pedestrian or animal is much greater than the heat coming to the camera from its surroundings. A signal processor translates the thermo gram data to an image suitable for display on a monitor.

4. WORKING PRINCIPLE

Night vision devices (NVD) work in the near infrared band at a wavelength of about 1 micrometer.For comparison, human visual range is about 0.4 to 0.7 micrometers.Unlie thermal imaging system, which may operate on complete darkness using heat radiation signatures, well beyond the visible light spectrum,NVD's rely on ambient ligh,often from the moon and stars. The intensifier tubes use the photoelectric effect. As a photon collides with a detector plate, the metal ejects several electrons that are then amplified into a cascade of electrons that light up a phosphor screen. Often a dim star in the sky is enough to illuminate an entire field. The night vision image does not have color information and hence monochromatic displays are sufficient. A green phosphor (P22) display is generally used as the human eye is most sensitive to the colour green in this wave length, which falls in the middle of the visible light spectrum.

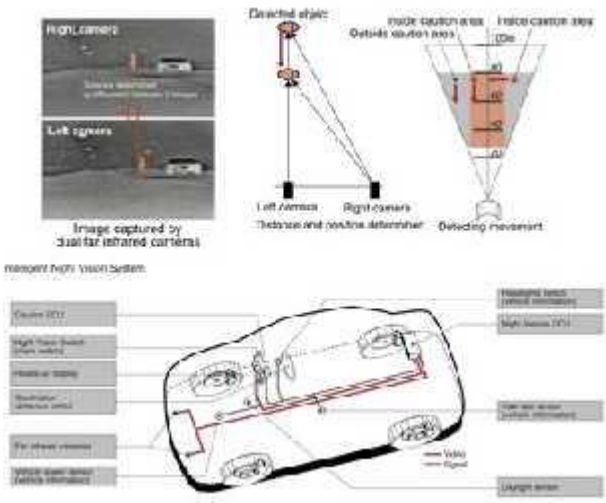
The latest generation of NVD uses a green yellow Phosphor (P43),and gives the operator a much more comfortable viewing experience. Current development by Photonic have also created a grey scale or black and white Phosphor (P45).



5. CONCERNS IN AUTOMOBILE

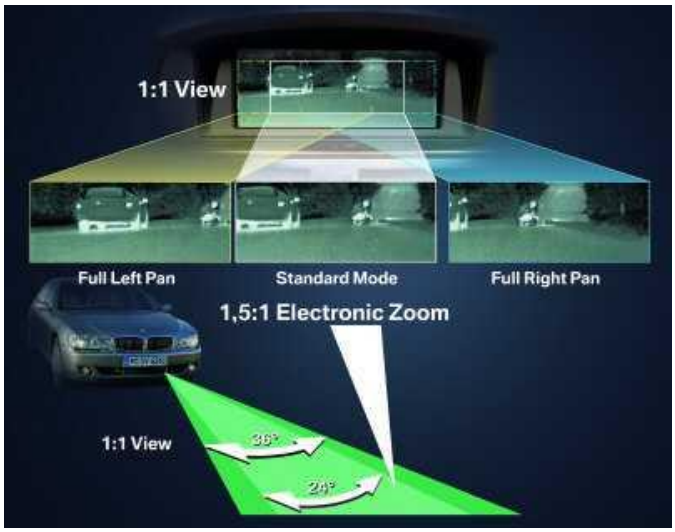
The streets of yesterday has turned to be monstrous night mare for the public with demon like vehicle that swift past the roads at very high speeds and the case gets worst in the night with drunken drives ruling the road with high stake speeds. The reckless accidents that occur on roads during night times mainly owe to the poor visibility and make the drivers rather than driving ahead, predict their way ahead. But this is not just the case of drunken drivers but also sensible drivers who find very bad visibility during the week hours of morning or the odd evenings.

The following paper were conceived as practical attempts to use available technology in an incremental manner to solve specific problems, like transport within a defined campus area or driving along a stretch of motorway during night times. The technologies are proven and the car manufacturing are putting in ample funding toward this technology that could also help unmanned vehicle for their effective motion and reduce the accident that are caused on the roads thus helping many.



The biggest problem with night vision is that these systems demand that the driver take his/her focus from the road, which is not a good idea and drives will just increase their speed, believing themselves to be less at risk. FIR systems offer a superior range and pedestrian detection capability, but their sensors cannot be mounted behind the windscreen or other glass surfaces.UMTRI studies comparing the ability of drivers to spot pedestrians using both the NIR and FIR devices showed that under identical conditions, the range of an FIR system was over three times further than that obtained with NIR-119 m compared with 35m.

If the driver was also given an automatic warning of the approaching object from the system, the detection distance and accuracy of detection improved for both systems, but the FIR approach still offered a better range.Moreover,drivers who tested the NIR system said that using it involved more effort.

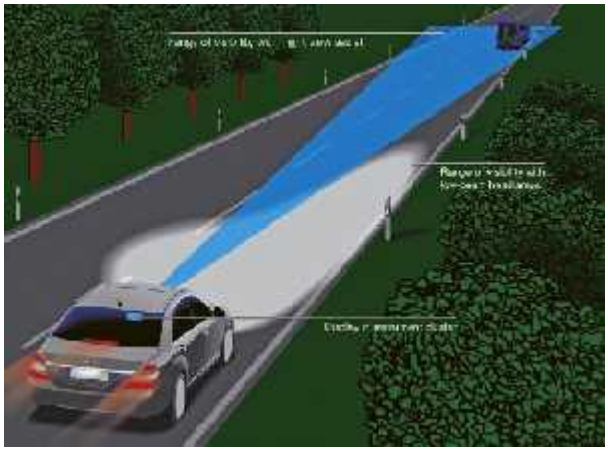


6. KEY FEATURES

- TV system: PAL
- Definition: 420 TV lines.
- Scan frequency: 60 Hz
- Minimum Illumination: 0 LUX
- 120 degree super wide viewing angle
- Size:28 mm x 42 mm
- Operation Temp: -20C ~ 50 C
- Operating Voltage : DC 12-volt
- Inside Mount: Fits into most vehicle key holes
- Water Resistant
- Manufacture pre-set mirror image feature(Always reverse vision)
- Full Motion Real Time colour video without delay.
- Display a reversed camera image on the monitor to duplicate the normal view seen in a rear-view mirror.
- Standard RCA video output

7. SAFETY BENEFITS

Road accidents involving pedestrians are far more frequency at night than during the day. Analysis of US traffic fatalities by the University of Michigan Transport Research Institute (UMTRI) has shown that the risk of a pedestrian fatality is around four times higher at night than during daylight hours, after all the contributing factors are taken into account. Although higher alcohol consumption, increased fatigue and greater exposure to animals on the road are partly to blame, an important factor is the driver's dramatically reduced range of vision.



One reason that driving at night is so difficult is that high beam headlights can rarely be used owing to the frequency presence of oncoming traffic. The experience is especially challenging for older drivers, who typically have shorter detection distances of just 30-50m for dark objects when driving with low-beams and facing oncoming vehicles.

The main safety benefit of night vision systems is to increase the driver's range of vision when using low beam headlights and emphasize the presence of animals, pedestrians, cyclists and other vulnerable road users.

8. ADVANTAGES

- Connect to any type of monitor with a composite yellow RCA jack for crystal clear resolution.
- Mounted inside will fit into most vehicle key holes, no other installation needed.
- Small compact size.
- Waterproof
- Low power consumption
- High sensitivity
- Low maintenance
- Easy and comprehensive installation

9. CONCLUSION

To put it in a nut shell it has become the need of the hour to have these kinds of hybrid safety systems on the latest

automobiles that could save the lives of many. All the automobile giants should divert their R&D work towards such innovatively and work upon developing such techniques one of which being the night vision sensors used in cars and other automobiles that are proving to be a great success in the west and this should be implemented immediately on the Indian terrain and reduce the catastrophic incident that occur on the roads especially during the night times. In the recent past small scale developments have come is looking forward for the world is looking forward for such creations to come into play.

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