IJEAST

INTERNATIONAL JOURNAL
OF ENGINEERING APPLIED SCIENCE
AND TECHNOLOGY

VOLUME : 4 ISSUE : 05 Print / Issue Publication Date: 09-Nov-2019

ISSN : 2455-2143

DOI : 10.33564/IJEAST.2019.v04i05.061

Indexed In

Google Scholar · Open Access · doi · Crossref

WWW.IJEAST.COM

editor@ijeast.com

International Journal of Engineering Applied Sciences and Technology, 2019
Vol. 4, Issue 5, ISSN No. 2455-2143, Pages 410-416
Published Online September 2019 in IJEAST (http://www.ijeast.com)

NEW TRENDS IN SATELLITE POSITIONING AND SURVEILANCE OF LAND VEHICLES

Michail Papoutsidakis
Dept. of Industrial Design and Production Engineering,
University of West Attica
Athens, Greece

Dimitrios Piromalis Chatzopoulos
Dept. of Industrial Design and Production Engineering,
University of West Attica
Athens, Greece

Avraam Chatzopoulos
Dept. of Industrial Design and Production Engineering,
University of West Attica
Athens, Greece

Abhishek Srivastava
Dept. of Engineering and Technology
Amity University
Noida, India

Abstract— **The aim of this dissertation is to study a car alarm, using the Global Positioning System (GPS) to locate its position. Specifically, it will refer to what we need to know about it, how it works, and how to optimize it.**

Keywords— **Watermarking, Haar Wavelet, DWT, PSNR**

I. INTRODUCTION TO ALARM-SENSOR SYSTEMS

A. Vehicle Alarm

Vehicle alarm is called the special electronic device installed in a vehicle and which is triggered by a tampering attempt through a sensor arrangement and other means. When the vehicle is violated, vehicle alarms are notified in the following ways or combinations of them: high frequency sound transmission (usually a siren, horn), pre-recorded voice warning, rhythmic light operation, wireless paging electronic signal. In addition to the alarm, the alarm can immobilize the vehicle (immobilizer function).

In modern alarms, the heart of the unit is a microcontroller with appropriate software, which attempts to cover as many problem scenarios as possible.

B. Alarm Sensors

Car alarms can be designed to be activated by:

- vibrations
- vehicle tilt (to prevent unauthorized towing)
- opening or closing special switches (eg door contacts)
- small but fast changes in battery voltage or ignition circuit
- presence detection sensors such as ultrasound, infrared or microwave sensors.
- Extremely loud noise near the vehicle

C. Crystal Breaking Sensors

If it takes too long for a thief to break the lock, the next move is to break the window. A fully equipped car alarm system has a device that feels this energy.

The most common glass break detector is a simple microphone that connects to the alarm microcontroller. The microphone measures changes in the air pressure variation and converts them into pulsed electric current of similar frequency. Glass that breaks has its own distinct frequency. The microcontroller has a Digital Signal Processing (DSP) that decides by measuring the frequency of the sound and changing its intensity if it comes from glass breakage. In this way, only this particular sound will trigger the alarm, and all other sounds are ignored.

D. Pressure Sensors

Another way of detecting the presence of an intruder is to monitor the air pressure level in the passenger compartment. Opening a door or breaking a window pushes or pulls air into the car, causing a rapid change in pressure. Fluctuations in air pressure are detected by an ordinary loudspeaker. Normally this is used to convert the changes of the electric current into sound but it can also work inversely. At that time, the pressure fluctuations move the cone of the loudspeaker, producing a current in the coil on it. When the alarm microcontroller receives a signal from the pressure sensor, it will cause an alarm.

International Journal of Engineering Applied Sciences and Technology, 2019
Vol. 4, Issue 5, ISSN No. 2455-2143, Pages 410-416
Published Online September 2019 in IJEAST (http://www.ijeast.com)

E. Space Sensors

Many car thieves do not want a whole car but individual parts of it. That's why you do not always have to open a door or a window. Having a towing truck, the thief needs only to lift the car and carry it all away.

To prevent the car from moving, some alarm systems include perimeter detectors, ie devices that control what's happening around the car. The most common perimeter detector is a radar consisting of a radio transmitter and a receiver. The receiver controls the reflections of the radio waves on the objects around the vehicle. Based on this information, the radar device can determine the location of any object in the surrounding area.

F. Tilt Sensors

Another way to protect against theft by towing truck is the tilt detector. The basic layout of a tilt detector is a series of mercury switches. A mercury switch consists of a pair of electrical contacts and a mercury sphere placed inside a cylinder. Mercury is a liquid metal and flows like water, but carries electricity like a solid metal. When the roller is tilted, the mercury is shifted so that it touches the pair of contacts located at one end of the cylinder. This turns off the electrical circuit and the signal goes to the microcontroller. When the roller tilts on the other side, the mercury rolls away from the cables by opening the circuit.

Tilt sensors are positioned at different angles and positions. When parking, some of them are in the closed position and some are in the open. If a thief changes the tilting of the vehicle (by lifting it by towing truck or jack), some of the closed switches open and some close, varying the state of the switches compared to that of the parking position.

G. Notification Systems

Regardless of how advanced sensors have an alarm, the system is not very good if it does not have an effective alert system.

G.a. Production of sounds

An alarm system has a siren that produces a variety of pertussing multitasking sounds. Strong noise prevents the thief, suspicious of passers-by. With some alarm systems, you can program a distinct range of siren noises so the vehicle owner can distinguish his alarm from other alarms.

Some alarm systems play a recorded message when someone is very close to the car. The main purpose of this feature is to let the attackers know that there is an advanced alarm system before trying anything. Probably an experienced car thief will completely ignore these warnings, but the occasional amateur thief can act as a powerful deterrent.

G.b. Personal alert / remote control

Many alarm systems include a built-in radio transmitter and a portable signal pickup device that someone can carry with them on the keychain. Portable remote controls (remote controls) enable the alarm to be controlled (eg on / off) remotely. This signal is encoded so that it is not easy to affect adjacent alarms or copied remotely.

G.c. Other features

Panic Mode: This function is activated by the remote control and activates the alarm even when it is switched off. It is useful if the attempted theft or robbery is done in front of the owner of the vehicle.

Today, alarms have seen a rapid development. Wired, wireless and hybrid panels are available in the global marketplace to meet any requirements and needs, all of which are always remotely and naturally through our smartphone device.

Fig. 1. GPS Mode Using Smartphone in Car

II. GPS-SATELLITE-RECEIVER OPERATION

A. Navigation system (GPS) mode

In summary, GPS is a positional (3-D) satellite, time and speed for a stationary and moving receiver over a very short period of time (from a few seconds to a few hours depending on the type of applications) overlooking classic terrestrial techniques implemented triangulation, tripling, or usually the combination of these two methods, providing the superficial ellipsoidal coordinates and the altitude that provides the third parameter, the altitude. It is based on the principles of operation of passive satellite systems and ensures continuous, global navigation regardless of weather conditions to an unlimited number of users.

International Journal of Engineering Applied Sciences and Technology, 2019
Vol. 4, Issue 5, ISSN No. 2455-2143, Pages 410-416
Published Online September 2019 in IJEAST (http://www.ijeast.com)

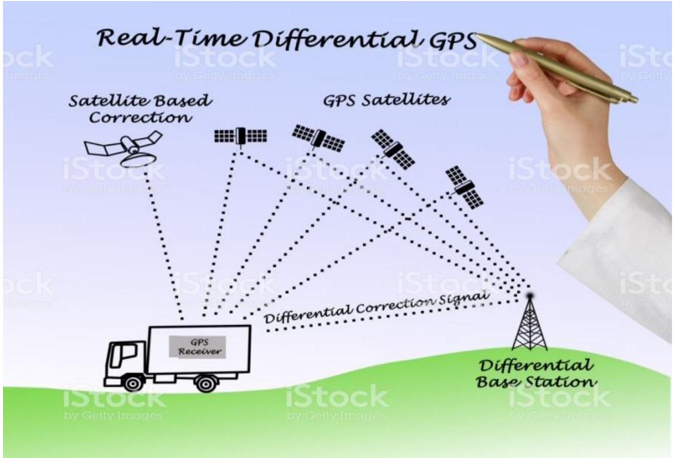

Fig. 2. Real Time Differential GPS

The basic principle on which it is based is the determination of position by measuring four "coordinates" between the observer and the satellite. That is why the design of the satellites' tracks has been made in such a way that it is possible to observe at least four satellites from anywhere on earth for every moment. In order to determine the location of a point in the space, it is sufficient to measure the distances from three known coordinate points. Of course, three satellites would be enough to determine the location of a point in the satellite reference system. The reason why at least four satellites (distances) are required is to determine the difference between the user's timer display and the satellite timer display, i.e. the delay of the receiver's timer relative to the GPS reference time. It is precisely for this reason that the existence of this error uses the term pseudo-disposition.

The GPS reference time is set at 00.00 UTC on January 5, 1980. The determined position (X, Y, Z) is reported in the World Geocentric Reference System 1984, known as WGS 84. The signal emitted by each satellite is unique and extremely composite and based on two carrier frequencies in the microwave range of multiple frequencies of 10.23 MHz.
L1 = 154 x 10.23 = 1575.42 MHz &
L2 = 120 x 10.23 = 1227.60 MHz,
More generally, for the elimination of systematic errors, several linear combinations such as L3 are used to overcome the two frequencies to eliminate the phenomenon of ionospheric refraction for better performance.
The signal is generated by the synthesis of two codes unique to each satellite, the C / A (coarse / acquisition) added only to the carrier (frequency) L1 and P (precision), formed on both frequencies L1, L2. Codes are also called pseudo-random because of the fact that it is possible to measure the pseudo-distortions mentioned above. The receiver (or navigation device) receives the signal, compares the received code with a copy produced by itself and ultimately identifies the signal and the time of the signal path multiplied by the speed of light c provides the distance between the receiver and the satellite . This distance is pseudo-distance and does not include time sliding between receiver and satellite timers, which is added as an extra unknown in the final calculation equation.
Below, there are reasons that may cause errors in the receiver location and the magnitude of the error in meters.

Cause (Error in meters)

- Ionospheric effect: (+ - 5µ)
- Satellite Clock Error: (+ - 2m)
- Impact effect: (+ - 0.5 m)
- Numerical errors in calculations: (+ - 1m)
- Astronomical Calendar Errors: (+ - 2.5m)
- Barriers (buildings, canyons, walls, etc.): (+ - 1m)

Measurements with a satellite tracking system can be divided into two main categories, depending on whether they are based on measurements:

- pseudo distances
- phases.

Higher than these are phase measurements, where the phase difference of the satellite signal at the time of transmission is measured with the signal phase of the receiver at the time of reception. The phase difference, in cycles multiplied by the λ wavelength, is converted to a distance.
At the time of reception, the receiver counts only the fractional portion of phase one and can not measure the integer number of cycles corresponding to the satellite-receiver distance. Therefore, phase measurements present the uncertainty problem in determining this N integer, which solves each receiver by the specific algorithm at the start of the measurements.
If a signal can not be received, a number of integer cycles are lost, resulting in all subsequent measurements being shifted to the same number of cycles. This problem (circle slipping) is treated like the unclear integer cycles from the receiver during pre-processing. The combination of phase and code measurements is considered the best one for detecting cycle slipping.

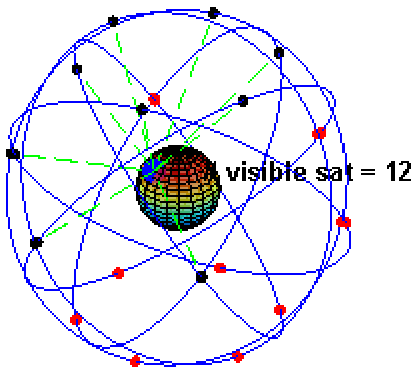

Fig. 3. Representing the Original Design of the GPS System with 24 Satellites (4 Satellites in each of the 6 Orbits)

B. Positioning Method

The RTK (Real Time Kinematic) method is a kinematic determination using two L1 / L2 base-rover and is the only one that can deliver results as well as real-time quality information for the solution . For the operation of the method, communication between the receivers is required, which takes place either with a UHF modem or with a GSM / GPRS modem. The mobile receiver constantly receives corrections from the base and uses them to resolve the phase ambiguity on the fly. Now, the user can capture in areas of limited satellite visibility (natural or artificial obstacles) without losing time to restart. The precision of this method is in the order of a centimeter and the time it takes is in the order of 1 second.

C. Satellite

The whole system consists of 28 artificial satellites. Global Positioning System (GPS) is the only fully functional satellite navigation system.

A GPS constellation that transmits accurate synchronization signals to GPS radio receivers allows us to determine exactly one location (longitude, latitude, height) day or night, at any time.

Since GPS became fully operational in 1993, it has become a vital and global utility tool, quite useful in the car and even more necessary for modern navigation. GPS also provides accurate time reporting required for some scientific research, including earthquake studies.

The extensive bandwidth augmentation system (WAAS), available since August 2000, increases the accuracy of GPS within 2 meters for compatible receivers. With GPS, precision can be improved to 1 centimeter, using other techniques such as GPS differential equation (DGPS).

Fig. 4. Navigon GPS Navigation Device on a Car Dashboard

D. **DGPS**

It is based on ground stations that broadcast on FM or AM. Not all receivers can take advantage of this signal. The range of stations reaches up to 600 km. The stations keep statistics on the location of the satellites so they can correct the errors in the signal and transmit them to the receivers to correct the calculations respectively.

The precision through correction reaches 3 - 5 meters.

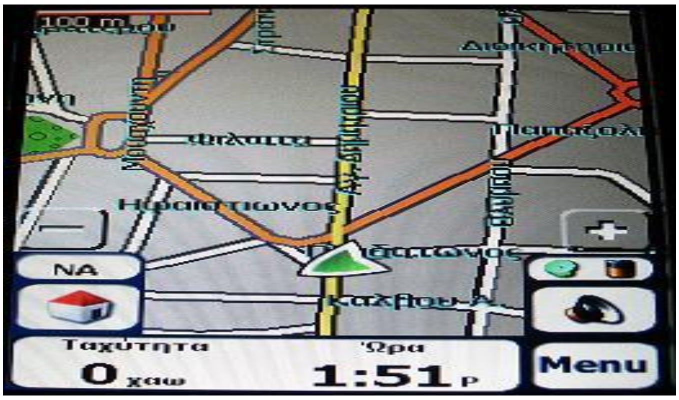

Fig. 5. GPS Navigation Device Displays

E. WAAS

The system consists of 25 ground stations in North America. It provides corrective data transmitted from a central ground station back to the satellites and satellites to the receivers. This means we do not have to be near a ground station to take advantage of this data.

The signals are transmitted as in the basic GPS, so there is no need for special circuits on the receiver.

The geostationary satellites supporting WAAS (latest information 02/2004) are above the Pacific and the Western Atlantic and cover North America.

It does, however, have few capabilities when used out of the ground station coverage area. In far distant regions (as in Australia) it has been observed that WAAS fixes have caused mistakes in calculations and therefore deviations from the receiver's location.

The precision through correction reaches 2 - 3 meters.

International Journal of Engineering Applied Sciences and Technology, 2019
Vol. 4, Issue 5, ISSN No. 2455-2143, Pages 410-416
Published Online September 2019 in IJEAST (http://www.ijeast.com)

Fig. 6. GPS Satellite Navigation, on a Smartphone, on a Bicycle

F. EGNOS-Galileo

The system is currently being used as a GPS correction, as is the WAAS. The receivers that support EGNOS also support WAAS. It was created for the needs of the European Union.

It consists of 3 geostationary satellites and 34 ground stations. In its full implementation, it will be a system similar to GPS, but it will work independently, called Galileo and supported by 30 satellites.

It has been in a trial period since 2000. Its full implementation is scheduled to be completed in 2014 [1] and will provide less than one meter accuracy.

G. Receiver

Satellite systems allow small electronic devices to determine locations (longitude, latitude and altitude) within a few meters using time signals transmitted by radio frequencies from satellites. Land receivers in a fixed location, of course, can also be used for scientific experiments that need positioning.

In order to have a navigator in the car, it is enough to have a suitable device that has built-in GPS. Since the 1990s, many car makers have begun to place a screen in the center console of the car, which, in addition to car-related functions (radio, consumption, travel computer, etc.), can also be turned into a navigator. To do this, the manufacturer must have supplied the vehicle with the necessary equipment (GPS, unit, antenna, etc.). The only thing the driver needs to do is to incorporate the maps in a way in the device.

If the manufacturer has not equipped the device with this device, the driver should be provided with a navigator (pocket pc), a watch and / or a mobile phone) and put it in a convenient way to monitor the point in the interior of the car to be guided by it. The advantage of this machine is that by being portable, besides the car, it can be used by its owner and elsewhere, such as a boat, a second car, home (if it is a computer).

Fig. 7. GPS Tracking Unit

H. Satellite / receiver cooperation

Various measurements can be made at the same time on different satellites, allowing for continuous mapping on the receiver and produced in real time.

Each measuring distance, regardless of the system used, places the receiver in a spherical position at a specific distance from the announcer. By taking a number of such measurements and researching a point where they meet, an imprint is produced. However, in the case of fast receivers, the position of the signal moves as signals are received from different satellites. In addition, radio waves show a slowdown as they pass through the ionosphere, this deceleration varies depending on the receiver's angle on the satellite, because the distance through the ionosphere changes.

The basic calculation attempts to find the shortest direction of the tangent angle at the 4 poles placed on 4 satellites.

Satellite navigation receivers reduce errors by using combinations of signals from multiple satellites and then using techniques such as Kalman filtering to reduce noise.

Fig. 8. Typical GPS Recorder

International Journal of Engineering Applied Sciences and Technology, 2019
Vol. 4, Issue 5, ISSN No. 2455-2143, Pages 410-416
Published Online September 2019 in IJEAST (http://www.ijeast.com)

I. Operation of the Receiver

The operation of a car navigation system is as follows:

a) Opening the device - and if it is a pocket calculator, choosing the navigation program we have got

b) Waiting to receive a satellite signal

c) Select a destination by entering a street or by specifying a point on the map

d) Selection of the mode of transition (sooner in km or via central roads)

e) Waiting to calculate the selected route

f) Route selection - appears on the screen and guides the driver all the way to the final destination, giving schematic and vocal directions for the course. The route selected is marked on the map with a different color so the user of the device can see the entire route they are going through.

Throughout the route it can also get information about the distance and time to the destination, the speed at which the vehicle moves, and the altitude that lies.

J. Other Features of a Receiver

Most navigation systems combine functionality with fun. With such a receiver, one can watch movies and video clips, listen to songs, connect to the Internet, and watch TV shows.

Also, it is important to point out that depending on the navigation program selected for the device, it is possible to update it with various software-provided add-ons that provide some facilities. There are several points of interest in each area, dangerous points of the streets, various shops, entertainment centers, banks, petrol stations, hotels, schools, sports centers, public services and much more depending on the program and its potential.

K. Select a Suitable Device

In order to choose the right receiver, if the car is not equipped in the first place, it should initially have decided exactly what it wants to do with the particular device except for its use as a navigator (eg a mobile phone or a computer). Then, the cost of each device is an important factor for the final choice and affects each prospective buyer.

All such devices are accompanied by a stand that is placed in the vehicle at a point visible to the driver but does not prevent it from driving. This means that you must have taken into account the space provided and the size of the device.

Fig. 9. Navigon Navigation GPS Navigon, Above the Dashboard - the Most Common Aftermarket Installation

Finally, the most important thing in the whole system is the software with which the device will be supplied. The browser should meet the user's requirements for use, be provided with appropriate, up-to-date maps, and be supported with upgrades (usually via the Internet) so that they can always give the right information. Also, upgrades include those that may have been added to the receiver, as they also need frequent updates.

L. Chronology

The first satellite system was a system built by the US Army in 1960. The satellites were installed on their designated tracks and broadcast (radio) signals at a known frequency. The received frequency differs slightly from the frequency of the radio transmission due to the satellite movement with respect to the receiver (Doppler effect). By controlling this frequency shift over a short period of time, the receiver can determine its position on one side or the other side of the satellite. Several such measurements are combined with accurate knowledge of the satellite orbit and can determine a particular location.

At the same time as GPS, the former Soviet Union has set up a similar positioning system called GLONASS. Originally, the GLONASS system was military, equivalent to GPS, and covered the needs of the former Soviet Union and its allied countries. With the dissolution of the Soviet Union and the changes at the political level, the use of the GLONASS system began to expand beyond the borders of the Soviet Union. In recent years an important effort has been made to work together with the GPS and GLONASS systems, which provide greater coverage of the earth's surface for users of these systems and a larger number of observed satellites.

III. WAYS TO OPTIMIZE CAR ALARM SYSTEMS

The evolution of technology allows old problems to be addressed with new and more effective solutions. So there are now new ways to better tackle the global and long-term problem of car theft.

Today's alarm systems are more sophisticated than ever before. In addition to sending alerts to the owner of the vehicle status, they can arm, disarm and control the vehicle through a smartphone. An additional feature offered by the most modern systems is the Remote Start engine.

Special alarms are integrated into the CAN-Bus electronics circuit, so no additional cables are needed and installation work, and they work with the car's factory control. For maximum safety, fully upgraded accessories and the simplest alarm system such as the perimeter sensor, crystal crash sensor, tilt or lift sensor and extra battery to power the system are available.

Another way to avoid theft of cars is through the OBD door. As is well known in every car there is the door with which we have access to the car's programming. For this reason, the OBD door extension and concealment products, anywhere in the vehicle, add one more bar for maximum safety of your car. The Can-Immobilizer is another product revolution in the car insurance market. As only the vehicle owner's personal password starts the operation of the vehicle.

The widespread use of satellites in GPS allows them to be exploited and to locate vehicles, for example, it can detect the car and in case of unauthorized movement it notifies the owner by SMS, but also with a link of Google Maps with its exact location . It can be combined with an existing alarm system or operate autonomously.

IV. ACKNOWLEDGMENTS

All authors would like to thank the University of West Attica for the financial support provided to them for this research project.

V. REFERENCES

[1] https://el.wikipedia.org/wiki/%CE%A3%CF%85%CE%BD%CE%B1%CE%B3%CE%B5%CF%81%CE%BC%CF%8C%CF%82_%CE%BF%CF%87%CE%AE%CE%BC%CE%B1%CF%84%CE%BF%CF%82

[2] https://securityreport.gr/magazine-archive/etos-2019/item/6819-i-istoria-kai-i-ekseliksi-ton-systimaton-synagermoy

[3] https://el.wikipedia.org/wiki/Global_Positioning_System

[4] https://en.wikipedia.org/wiki/Vehicle_tracking_system

[5] https://en.wikipedia.org/wiki/GPS_tracking_unit

[6] https://www.google.gr/search?q=gps+tracker&source=lnms&tbm=isch&sa=X&ved=0ahUKEwj99Yvf66LiAhUBzKQKHW7NBskQ_AUIDigB&biw=1280&bih=625#imgrc=--4Ia8hFrbeXdM:

[7] https://el.wikipedia.org/wiki/%CE%A3%CF%8D%CF%83%CF%84%CE%B7%CE%BC%CE%B1_%CF%80%CE%BB%CE%BF%CE%AE%CE%B3%CE%B7%CF%83%CE%B7%CF%82_%CE%B1%CF%85%CF%84%CE%BF%CE%BA%CE%B9%CE%BD%CE%AE%CF%84%CE%BF%CF%85

[8] https://www.google.gr/search?biw=1280&bih=592&tbm=isch&sa=1&ei=_L3eXJWACNqR1fAPy8i86Ak&q=gps+tracker+smartphone&oq=gps+tracker+smartphone&gs_l=img.3..0i8i30j0i24l2.111693.119991..120101...2.0..0.138.2128.0j16......0....1..gws-wiz-img.......0j0i30j0i19j0i5i30i19j0i8i30i19j0i5i30.RqOTKa6HJZM#imgdii=0ZHcCPsdYbaWMM:&imgrc=PsnXCqzhNhhyOM:

[9] https://www.google.gr/search?q=edwin+holmes+burglar+alarm&source=lnms&tbm=isch&sa=X&ved=0ahUKEwi6zNW03aLiAhVN8aYKHT8zCYsQ_AUIDigB&biw=1280&bih=592&dpr=1.5#imgrc=5zTj7G-zlof87M:

[10] https://www.google.gr/search?biw=1280&bih=592&tbm=isch&sa=1&ei=Mr_eXNexH4uxU5qAn_AN&q=augustus+russell+pope+&oq=augustus+russell+pope+&gs_l=img.3..0i30j0i5i30.9847.9847..10190...0.0..0.130.130.0j1......0....1..gws-wiz-img.Im120Ou6xWg#imgrc=At_KSItdJOpmIM:

[11] https://www.google.gr/search?biw=1280&bih=592&tbm=isch&sa=1&ei=Hr_eXKrrM6PmgweL44ngBw&q=edwin+holmes+&oq=edwin+holmes+&gs_l=img.3..0i30.505751.505751..506160...0.0..0.131.131.0j1......0....1..gws-wiz-img.I7fys3PSigI#imgrc=yOgfylLt1x9T0M:

IJEAST

INTERNATIONAL JOURNAL
OF ENGINEERING APPLIED SCIENCE
AND TECHNOLOGY

ABOUT IJEAST

International Journal of Engineering Applied Science and Technology (IJEAST) is a peer-reviewed, open access journal that publishes high-quality research papers in the field of Engineering, Applied Science and Technology.

IJEAST aims to provide a platform for researchers, academicians, and professionals to share their innovative ideas, research findings, and practical experiences with the global scientific community.

FOCUS AREAS

- Engineering
- Applied Science
- Technology
- Innovation & Development
- Interdisciplinary Studies

PEER REVIEWED

All submissions are rigorously peer reviewed to ensure quality.

OPEN ACCESS

Free and unrestricted access to research for all.

GLOBAL REACH

Connecting researchers and professionals worldwide.

TIMELY PUBLICATION

We ensure a swift and efficient publication process.

For more information, visit our website
www.ijeast.com

INTERNATIONAL JOURNAL
OF ENGINEERING APPLIED SCIENCE
AND TECHNOLOGY

editor@ijeast.com
www.ijeast.com
India

2455-2143