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SINGLE FREQUENCY GPS RECEIVER AND IMU OF MEMS USED IN CIVIL ENVIRONMENT FOR VEHICLE NAVIGATION

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Abstract:

The proportion of air pollution which is caused by the cars is increasing .In order to solve this serious problem, many countries and regions have already presented a series of emissions standards, meanwhile some methods have been developed, include update motor engine or improve the quality of the gasoline. However, these actions have not brought about a striking effect as we expect. There are also some situations to fail implement these emissions standards. In this project, a Wireless Inspection and Notification System (WINS) through the concept of Internet of Things (IoT) is proposed. By applying the system, it is possible to smoothly realize a green traffic network .In this system, GPS AND GSM technology as low-cost and mature wireless communication method is adopted to collect and transmit emissions information of vehicles. Moreover, The GPS, GSM devices need to be installed on the traffic lights so that reliable reading of emissions signals from a vehicle can be interrogated when the vehicles stop in front of the red light. Taken into consideration the real environment, an efficient and innovative maximum spanning tree algorithm (MXAST) is also presented to select suitable traffic lights aim to reduce the number of temperature sensor and co2 sensor devices(more

economy)and guaranteed the whole urban car scan be monitored.

Keywords:*GSM,GPS,Zigbee,MEMS,Raspberry-pi.*

Introduction:

With the increasing of automobile quantity, especially in some metropolis, such as Beijing or Hong Kong, it is very impending to resolve the problem of air pollution resulting from automobile exhaust gas .In Beijing, air pollution has reached levels judged as hazardous to human health. To fight this problem, the motor emissions standards have been established and promoted in many countries for many years. Furthermore, some improved measures in vehicle engines or the quality of gasoline have also been developed by researchers. However, these methods seem not to solve radically the emissions pollution problems .The motor emissions standard is very difficult to implement in real-life. Although government forces all cars for testing or examining periodically as the local standard, the actual vehicle on-road emissions are usually much higher than those which are measured during the emission inspections .As a result, a new system is proposed to deal with the thorny issues. Along with continually updated wireless communication and signal acquisition technologies through the concept to IoT, an effectively wireless inspection and notification system (WINS) has been developed in this project. It can realize real-time monitor all cars emissions information in a city .In the system ,the cars need to be tagged with unique identity (ID),their emissions information will be transferred with the ID to a backend system. Then, the authorities can smoothly judge which car fail to this test (exceed the standard) andgive a notice (message &email) to ask drivers to repair their cars .To specially mention, traffic light is also a critical role in the whole system .It is a central component in the traffic system that no car could avoid it to drive in a city .In order to achieve the goal that monitoring closely all the motor vehicles, RFID reader will be installed on the traffic light. It is well known that every car must stop in front of the red light for a long time.

Literature Survey:

LVNS has been a major focus for research over the past decade. The aim of such a system is to accurately locate a vehicle on a road network, and thus the positioning technology is an important requirement. An ideal positioning technology in LVNS will have the following characteristics:

- Ability to provide continuous and reliable navigation solution.
- Ability to maintain acceptable accuracy levels the accuracy requirement for a land vehicle generally varies with the application

For instance, the acceptable accuracy level for emergency services like an ambulance is 15- 20 m (2D, 95%), whereas the corresponding requirement for an autonomous car is at the sub-meter level. 2 Different technologies exist to determine the position of a vehicle, out of which two are used most commonly. The first is the Global Positioning System (GPS) which relies on the radio-frequency (RF) signals from satellites in space which have known locations. The second technology is an Inertial Navigation System (INS), which is a self-contained Dead Reckoning (DR) navigation system, and provides dynamic information through direct measurements from an Inertial Measurement Unit (IMU). Over the years, increasingly falling cost of GPS receivers has rendered the system attractive for the design of LVNS.

The primary advantage of using GPS includes its ability to provide absolute navigation information, and the long term accuracy in the solution. Being a satellite-based navigation system, GPS requires line-of-sight (LOS) between the receiver antenna and the satellites. However, in the case of a land vehicle, the LOS criteria may not always be met, because a land vehicle typically moves in urban and under dense foliage environments which prevent signals from reaching the antenna. Thus, signal interruption is one of the primary reasons which affects the continuity and reliability of the navigation solution from GPS.

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Unlike GPS, an INS is a self-contained DR navigation system which provides position and velocity information through direct measurements from an IMU. The advantage of INS over GPS is its independence from external electromagnetic signals, and its ability to operate in all environments.

This allows an INS to provide a continuous navigation solution, with excellent short term accuracy. However, the INS suffers from time-dependent error growth which causes a drift in the solution, thus compromising the long term accuracy of the system. The drift of high quality inertial devices is small, and can fulfill the accuracy requirement in land applications for longer periods. However, there are two specific limitations for their use in general applications, such as LVNS. One is their price (over US $90,000 for a high-end IMU and over $10,000 for medium grade IMUs), and the other is the regulation by the governments against their unrestricted use. Due to these limitations, the use of INS has generally been confined to only high accuracy navigation and geo-referencing applications. Recently, with advances in Micro Electro-Mechanical Systems (MEMS) technology, low cost MEMS-based inertial sensors are available. the specifications and requirements needed for commercial applications, like 4 vehicle navigation Their combination not only offers the accuracy and continuity in the solution, but also enhances the reliability of the system. GPS, when combined with MEMS inertial devices, can restrict their error growth over time, and allows for online estimation of the sensor errors, while the inertial devices can bridge the position estimates when there is no GPS signal reception. Also, the use of inertial components allows the GPS measurements to be compared against statistical limits and reject those measurements that are beyond the limits, thus enhancing the reliability and integrity of the system.

As GPS/MEMS INS (INS utilizing MEMS IMU) systems constitute an increasingly attractive low cost option, it is of significant importance to evaluate their performance. Thus, the broad aim of this project is to evaluate the performance of a GPS/MEMS INS 5 integrated system, and to develop a system capable of providing an accurate navigation solution, reliably and continuously for land vehicle navigation application. The need to maintain reasonable cost levels when integrating an INS with GPS for consumer applications is driving the technology development for MEMS inertial sensors development ever since. [9] discussed about Positioning Of a Vehicle in a Combined Indoor-Outdoor Scenario, The development in technology has given us all sophistications but equal amounts of threats too. This has brought us an urge to bring a complete security system that monitors an object continuously. Consider a situation where a cargo vehicle carrying valuable material is moving in an area using GPS (an outdoor sensor) we can monitor it but the actual problem arises when its movement involves both indoor (within the industry) and outdoor because GPS has its limitations in indoor environment. Hence it is essential to have an additional sensor that would enable us a continuous monitoring /tracking without cutoff of the signal. In this paper we bring out a solution by combining Ultra wide band (UWB) with GPS sensory information which eliminates the

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limitations of conventional tracking methods in mixed scenario(indoor and outdoor) The same method finds application in mobile robots, monitoring a person on grounds of security, etc.

Proposed System:

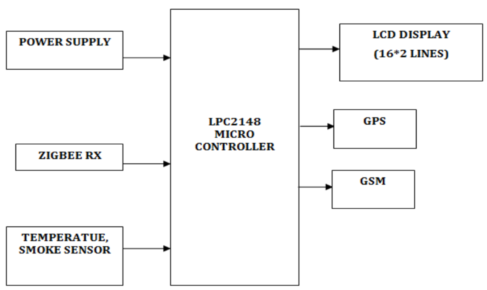

Fig:1:Block diagram

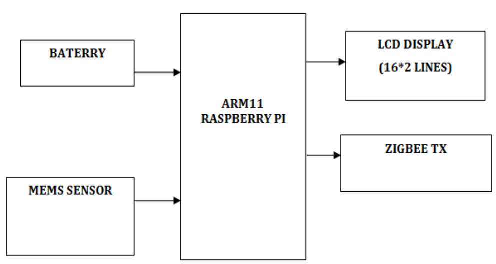

Fig:2:Block diagram

Methodology:

Micro controller: This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

Raspberry Pi : The Raspberry Pi delivers 6 times the processing capacity of previous models. This second generation Raspberry Pi has an upgraded Broadcom BCM2836 processor, which is a powerful ARM Cortex-A7 based quad-core processor that runs at 900MHz. The board also features an increase in memory capacity to 1Gbyte.

Liquid-crystal display (**LCD**) is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock.

GSM:

Global System for Mobile Communication (GSM) is a set of ETSI standards specifying the infrastructure for a digital cellular service.The network is structured into a number of discrete sections.Base Station Subsystem – the base stations and their controllers explained.Network and Switching Subsystem – the part of the network most similar to a fixed network, sometimes just called the "core network" GPRS Core Network – the optional part which allows packet-based Internet connections Operations support system (OSS) – network maintenance.SM was intended to be a secure wireless system. It has considered the user authentication using a pre-shared key and challenge-response, and over-the-air encryption. However, GSM is vulnerable to different class of attacks, each of them aiming a

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different part of the network.

Fig:3: GSM Module

GPS:

Global Positioning System (GPS) technology is changing the way we work and play. You can use GPS technology when you are driving, flying, fishing, sailing, hiking, running, biking, working, or exploring. With a GPS receiver, you have an amazing amount of information at your fingertips. Here are just a few examples of how you can use GPS technology. GPS technology requires the following three segments.

- Space segment.
- Control segment.
- User segment

Space Segment

At least 24 GPS satellites orbit the earth twice a day in a specific pattern. They travel at approximately 7,000 miles per hour about 12,000 miles above the earth's surface. These satellites are spaced so that a GPS receiver anywhere in the world can receive signals from at least four of them.

Control Segment

The control segment is responsible for constantly monitoring satellite health, signal integrity, and orbital configuration from the ground control segment includes the following sections: Master control station, Monitor stations, and Ground antennas.

User Segment

The GPS user segment consists of your GPS receiver. Your receiver collects and processes signals from the GPS satellites that are in view and then uses that information to determine and display your location, speed, time, and so forth. Your GPS receiver does not transmit any information back to the satellites.The following points provide a summary of the technology at work:

- The control segment constantly monitors the GPS constellation and uploads information to satellites to provide maximum user accuracy
- Your GPS receiver collects information from the GPS satellites that are in view.
- Your GPS receiver accounts for errors. For more information, refer to the Sources of Errors.
- Your GPS receiver determines your current location, velocity, and time.
- Your GPS receiver can calculate other information, such as bearing, track, trip distance, and distance to destination, sunrise and sunset time so forth.
- Your GPS receiver displays the applicable information on the screen.

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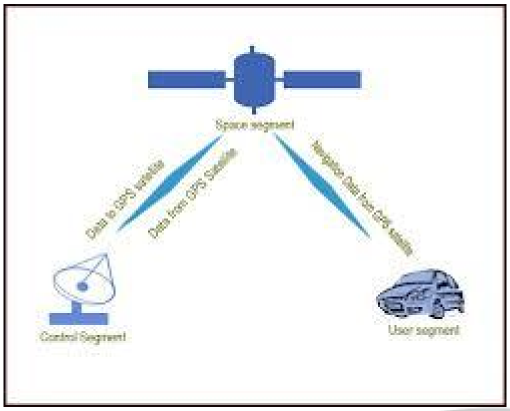

Fig:4:GPS Working

Temperature sensor:

A thermistor is a type of resistor whose resistance is dependent on temperature. Thermistors are widely used as inrush current limiter, temperature sensors (NTC type typically), self-resetting over current protectors, and self-regulating heating elements. The TMP103 is a digital output temperature sensor in a four-ball wafer chip-scale package (WCSP). The TMP103 is capable of reading temperatures to a resolution of 1°C.

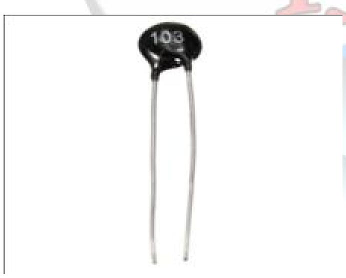

Fig:5:Temperature sensor

Smoke sensor:

They are used in gas leakage detecting equipments in family and industry, are suitable for detecting of LPG, i-butane, propane, methane, alcohol, Hydrogen, smoke. The surface resistance of the sensor Rs is obtained through effected voltage signal output of the load resistance RL which series-wound. The relationship between them is described:

Rs\RL = (Vc-VRL) / VRL

Fig:6: Smoke sensor

MEMS:

Micro-Electro-Mechanical Systems (MEMS) is the integration of mechanical elements, sensors, actuators, and electronics on a common silicon substrate through micro fabrication technology. While the electronics are fabricated using integrated circuit (IC) process sequences (e.g., CMOS, Bipolar, or BICMOS processes), the micromechanical components are fabricated using compatible "micromachining" processes that selectively etch away parts of the silicon wafer or add new structural layers to form the mechanical and electromechanical devices. MEMS promises to revolutionize nearly every product category by bringing together silicon-based microelectronics with micromachining technology, making possible the realization of complete systems-on-a-chip. MEMS is an enabling

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technology allowing the development of smart products, augmenting the computational ability of microelectronics with the perception and control capabilities of micro sensors and micro actuators and expanding the space of possible designs and applications.Microelectronic integrated circuits can be thought of as the "brains" of a system and MEMS augments this decision-making capability with "eyes" and "arms", to allow micro systems to sense and control the environment. Sensors gather information from the environment through measuring mechanical, thermal, biological, chemical, optical, and magnetic phenomena. The electronics then process the information derived from the sensors and through some decision making capability direct the actuators to respond by moving, positioning, regulating, pumping, and filtering, thereby controlling the environment for some desired outcome or purpose. Because MEMS devices are manufactured using batch fabrication techniques similar to those used for integrated circuits, unprecedented levels of functionality, reliability, and sophistication can be placed on a small silicon chip at a relatively low cost.

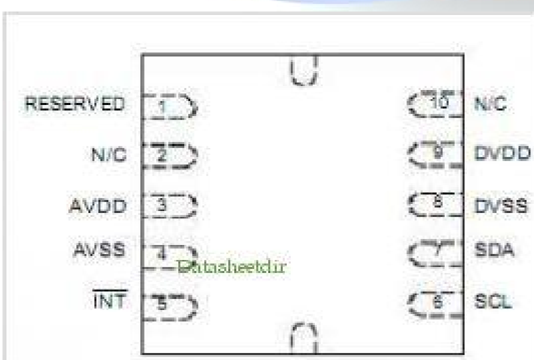

Fig:7:MEMS IC

ZIGBEE:

Zigbee modules feature a UART interface, which allows any microcontroller or microprocessor to immediately use the services of the Zigbee protocol. All a Zigbee hardware designer has to do in this caseis ensure that the host's serial port logic levels are compatible with the XBee's 2.8- to 3.4-V logic levels. The logic level conversion can be performed using either a standard RS-232 IC or logic level translators such as the 74LVTH125 when the host is directly connected to the XBee UART. The X-Bee RF Modules interface to a host device through a logic-level asynchronous Serial port. Through its serial port, the module can communicate with any logic and voltage Compatible UART; or through a level translator to any serial device. Data is presented to the X-Bee module through its DIN pin, and it must be in the asynchronous serial format, which consists of a start bit, 8 data bits, and a stop bit. Because the input data goes directly into the input of a UART within the X-Bee module, no bit inversions are necessary within the asynchronous serial data stream. All of the required timing and parity checking is automatically taken care of by the X-Bee's UART.

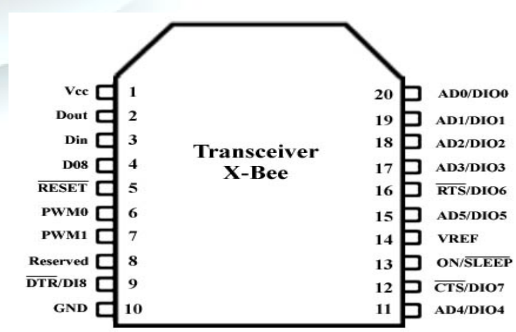

Fig:8:ZIGBEE pin diagram

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Result:

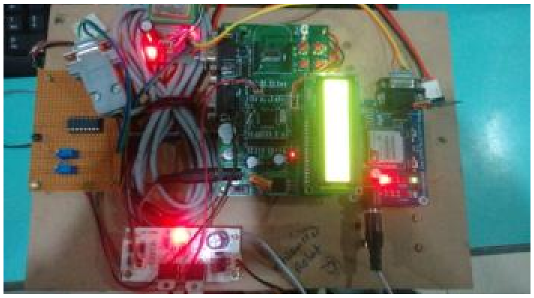

Fig:9:pic:vehicle(robotic) section

Fig:10:pic:monitor section

Fig:11:Message Sending To User

Fig:12:Temperature And Smoke Sensor Results

CONCLUSION AND FEATURE SCOPE

This paper has proposed a novel DGPS/IMU integration approach that significantly improves performance, compared to EKF solutions. Such performance improvement is especially needed in urban environments.

There are a variety of possible directions for future work to improve the performance of the proposed system

• Develop and demonstrate reliable methods to check the measurement residuals to reject outliers.

• Develop real-time algorithms that allow correct modelingof the correlation between satellites in the integer freemeasurements. This was ignored in this paper. Oneapproach is to add the receiver clock bias into the state vector to avoid the double-differencing, thus avoiding introducing the correlation between satellites.

• Develop CRT methods to reliably resolve the integer ambiguity to achieve centimeter positioning accuracy using single frequency receivers. The CRT framework has the potential to increase the success rate of real-time integer ambiguity resolution.

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• Construct the optimal integer-free phase tracks Ξ in the CRT window to maximize the information extracted from phase measurements.

• Test the algorithm using data from a low-cost, single frequency receiver to evaluate robustness to the noisy signal, and also reception from a low-cost GPS antenna.

• Augment additional states per satellite to model GNSS time correlate measurement errors such as multipath.

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