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RESEARCH ARTICLE

Implementation of Automated Gas Leakage Monitoring System Using Zigbee

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***Abstract*—Gas leakage is the main problem in the current scenario. It may lead to any hazardous situation if it is unchecked. In this paper the Gas leakage is monitored using an automated system. In this automated gas leakage monitoring system the data transmission is carried out by using a Zigbee Network and a sensor. Sensor collects the data and the collected data is monitored in real time. The data transferring is done through Zigbee device. In the present situation the world is facing huge amount of security threat and attacks on the data transmission system. The main task is to overcome the problem on data transmission and to improve the security system. This paper will give a better way for securing from unauthorized access of the data transmitted over a certain distance. It also focuses on the wireless communication that can be used to monitor the gas leakage in a plant or industry using the Zigbee technology.**
***Keywords*— Gas leakage, Microcontroller, Zigbee**

I. INTRODUCTION

Automation has become one of the main features of new generation in an Industry. In this day and age Industrial growth is very rapid and incessant in terms of improvements and technology. Consecutively security concerns would also be focused particularly in risky working parts. Privation of safety processes effects in adversarial effects and small abandon may result in secure obliteration equipment and workers. Therefore real time monitor of the equipment for any leakage of gas should be needed to avoid the unnecessary accidents and provide healthy environment. Industries are not progressive and covering in technology to recognize the gas escape point. WSN is used for more complete control and low power intake [1]. Wireless sensor network is a network in which few types of sensor swellings are organized. Wireless sensor network is accessible, consumes very little power, fast data acquisition and software programmable. A WSN (wireless sensor network) usually contains of base position (or) gateway that can lead into with a number of wireless sensors via a radio links. WSN can eliminate the cost of installation, maintenance. and excludes connectors. Zigbee is a low-cost, low-power, wireless mesh network standard. The low cost allows the technology to be far and wide organized in wireless control and monitoring applications, the low power-usage consents longer life with smaller batteries, and the mesh networking delivers high dependability and larger range. The sensing technologies agree to the credentials of pests in the crops, abundance or augmented moisture. Zigbee technology can be smeared for wireless applications in agriculture sector. In harvest field monitoring, mesh topology is used and the data that is perceived from several sensors goes to the central Global System for Mobile (GSM) [2] node which will send the information to the personal computer used by the farmer [3]. This paper shows the model for impeccable real time monitoring of crop field by using Zigbee network and it even displays the tentative results when the nodes are organized in real time. Physical and MAC (Medium Access Control) layers of Zigbee are maintained by IEEE 802.15.4. The function of source and receiver are combined into a single device known as transceivers. The fundamental concept is to provide a highly aided monitoring of crop field by concentrating on the data that is received from various sensors in the paddy crop field. The advantages of wireless monitoring are

Minimum Cost: One of the prime advantages of WSN is the installation and functioning costs are tends to be minimum. Data collectors are deliberated by many to be the lowest cost method for monitoring vibration. With monthly or quarterly route running, companies can preclude many letdowns and provide an suitable cost rationalization to management. While the installed costs of data collectors are typically the lowest, operating costs are higher due to persistent effort expense. When evaluated over a period of time, the overall cost of a data collector system will be analogous to a low cost observation system. In addition to equivalent costs, wireless systems provide more frequent readings for enhanced identification of short time-to-failure locations.[4] Advanced Technology: These customary cost rationalizations only touch upon a ration of the rewards of prevalent condition monitoring sensors. Considerably similar cellular phones, low-cost, wireless CM sensors can modification the technique industrialized facilities are track. Hence this technology is advanced than any other existing technologies. Some companies apprehend the significance of quivering analysis, but only relate it to grave applications. Many amenities account for unplanned downtime with excess creation capacity. In petrochemical and petroleum refining plants, up to 10% of the assembly capacity is required to account for inadvertent maintenance. Prevalent usage of condition monitoring sensors can monitor up-to-

date machine state so that unprepared downtime can be considerably abridged. Maintenance responsibilities can be synchronized with production industrial action so that most, if not all, work stoppage can be premeditated and enhanced

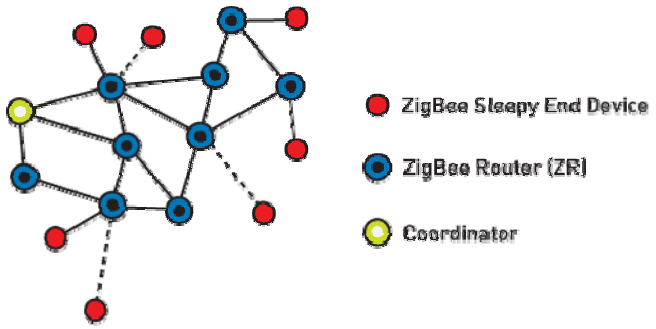

Figure.1 Zigbee networking

A. Implementation of WSN

Every company are trying to diminution implementation costs. Conversely, capital investment is not the only concern, but also installation costs, training, documentation, additional parts, and cost of production losses. The key for common implementation is ease of installation and ease of maintenance of the system.

1) Plug-and-play connectivity

It is easy to do Physical installation of the sensor, turning it on, and configuring. In the case of a wireless accelerometer, assigning the sensor with a standard ¼-28 negotiated intensifying knob and plugging in the battery. The sensors are designed at a main computer, which should take less than a couple minutes per sensor.

2) Smart sensors and uses

Intellectual sensors and software that assistance by start-up and conservation are also significant for ease of use. A wireless sensor should be capable to control a route back to the main computer database without arrangement by an operator. System components such as repeaters should work impeccably without operator involvement.

3) Expandability

The next step in pervasive enactment is an easy-to-expand system with no unconnected input limitations. Companies can purchase and install a handful of sensors on a monthly basis. Installation doesn't require extensive planning or prolonged cessation periods. Sensors can also be repositioned very easily. Increased Reliability: Sensors equestrian within range of several transceivers should permit transecting and be error tolerant. As network conditions change the system should also regulate and acclimate so that data collection remains dependable deprived of operator interface.

4) Long life

Battery life suits very important when dealing with large quantities of sensors. Power management is critical to battery life because frequently relieving batteries on hundreds of sensors would be insurmountable.

II. PROPOSED SYSTEM-IMPLEMENTATION OF ZIGBEE

Recently many wireless sensor technologies have been introduced for a wide range of applications. The superior technology over another is delegated by the application's requirements, usability, and availability, surrounding environment, power consumption, security features and other factors. In this paper, the chosen wireless sensor technology to be implemented. Requirements are:

- Low power consumption and Low Cost

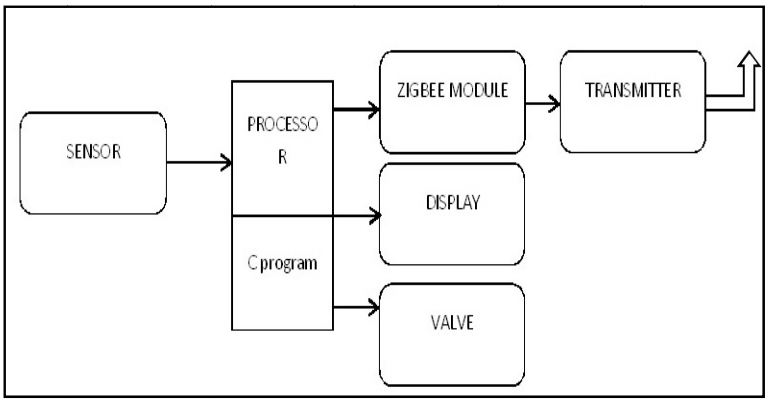

Figure.2 Zigbee based Transmission system

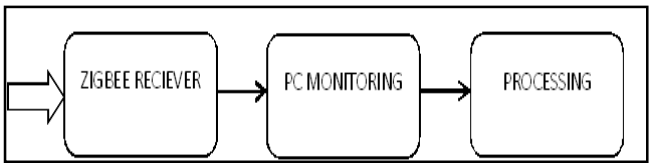

Figure.3 Zigbee based Reception

a)Construction and Working: When the power is switched on the sensor gives the signal which is the measured signal which will be mille-ampere range. It is amplified in to higher level and converted in to digital signal using a amplifier and ADC respectively. Then the signal will passed to processor where the calculation and variation manipulation are taking place. The processor is coded with c program when the sensor sensing the gas leakage the microprocessor will initiate the buzzer and alarm. The amount of leakage along with the leakage level is send to the receiver through Zigbee model. This system monitors the environment closely and continuously. The controlling personal or the engineer can take further calculation from the received data from the transmitter. A further decision can be taken according to the collected data. The receiving part also contains a Zigbee model. This system both transmitter and receiver are placed apart since it is WSN. Hence the overall communication in the measurement system is taking place through Zigbee module. Suitable driver circuits have to be considered for activating the valve and exhaust fan using relays. An additional inverter may be prerequisite to interface domestic exhauster so that it can operate in parallel with it even during power failure and eradicates need for two exhaust fan. Gas Leakage is checked animate on a monitor. If gas leakage is further than 500 ppm then additional gas leakage is check or control by automatically functioned protecting valve. ARM design is attuned with all four major stage functioning organisms: Symbian OS, Palm OS, Windows CE, and Linux. ARM is the trade standard embedded Microcontroller architecture, and is a front-runner in low-power high presentation cores. ARM also has a large partner network subsidiary the complete design and improvement cycle. ARM is a full-solutions provider, ancillary a broad range of applications [4].

The LPG sensor to detect the occurrence of a precarious LPG leak in our home or in a service Station, storage tank environment and even in vehicle which uses LPG gas as its fuel.MQ-6 gas sensor is used to sense the pestilential gas and has high thoughtfulness to LPG and also retort to Natural Gas. The sensor has admirable indifference individual with a Quick response time. When the object ignitable gas exist, the sensor's conductivity is higher laterally with the gas deliberation rising. The Zigbee family of Zigbee 802.15.4 RF modules is the best option for exceptional wireless performance in a low cost. Each Zigbee module comes in either a normal or distant PRO version. Zigbee 802.15.4 companionable RF Modules, counting entries, device adapters and extenders, Obtainable in Series 1 or Series 2 models for point-to-multipoint or mesh topologies, Pin-swappable regular and long-range –PRO versions, Low cost Common footprint for a variability of Digi RF modules, Low-power sleep modes, Multiple antenna possibilities Industrial temperature (-40º C to 85º C)[1][2][3].

b)IEEE 802.15.4 Zigbee: The new miniature range, low power, low rate wireless networking Zigbee regular, IEEE 802.15.4 [5] [10] [2] supplements the high data proportion technologies such as WLAN and open the access for several new applications. Zigbee is based on DSSS and it uses binary phase shift keying (BPSK) in the 868/928 MHz bands and offset quadrature phase shift keying (O-QPSK) modulation at the 2.4 GHz band. While Bluetooth devices are more suitable for objectively in elevation rate sensor applications and voice applications, Zigbee is better appropriate for low rate sensors and devices recycled for control applications that do not oblige high data rate but must have elongated battery life, low user interpolations and mobile topology. Zigbee is intended as a low complication, low cost, low power ingestion and low data rate wireless connectivity standard. Zigbee maintenances scalable data rates, for example, it can be used for medical file transfer at the rate of 250 kbps while supporting sensor based applications at the rate of 20 kbps. As industry appearances sustained pressure to moderate its carbon footprint and deliver increased dependability, plant and processes managers are taking improvement of new technologies in wireless intuiting solutions for evaluating, monitoring, and control. In this day and age, looking at alternative vitalities to power their designs are turning to vibration-energy ingathering, which can be magnificently integrated with electronic systems, allowing plant operators to organize reliable wireless sensing systems plant-wide. In many applications where condition statistics is required, energy is available in kinetic form. A vibration energy combine, also called a generator, is a device that adapts the vibration of a piece of plant or machinery into operational electrical energy. Innovative traditional technology has been formed the first commercially obtainable vibration energy combine for the industrial market segment – the PMG17. Premeditated to reverberate at twice mains frequency (100 or 120Hz),Output levels are typically enough to power a wireless receiver sending several Kbytes of data every few minutes, or temperature analyses numerous times a second. The resounding frequency residues stable through a wide temperature range from -40°C to +85°C and the whole package is hermetically impenetrable alongside the environment.

WSN technology is used in enhancing the process of well drilling. New well-being monitoring systems are also being there organized in harsh and remote locations like offshore rigs. The developing demand for energy worldwide is driving oil consideration and efficient and less expensive options like WSN will be at the front. WSN provides revenues for real-time production monitoring with well-organized acquisition and transmission of data. The technology fits well in Hard environments, has cost remunerations and supports temporary organizations and sensor enlargements. In the long run, if fully implemented, the consequent benefits exclude remote equipment conclusion, reduced equipment letdowns and shutdowns. WSN is also at the front position of value-added seismic surveys. The process of accompanying surveys in deep and remote sections has been abridged and lengthened, providing a prospect for millions of seismic sensors organization around the world. Respectively piece of plant equipment has a irreplaceable signature vibration evaluation and the devices are installed to ration and transmit vibration ranges. The vibration reading change (for example as a result of incipient bearing failure) operatives would be alerted immediately, secondary predictive maintenance and also precluding redundant inflated interruption. The PMG17 is previously in expenditure in the Nyhamna gas plant in Norway, firing its networks wireless sensor nodes. Operative faultlessly notwithstanding a wide range of temperatures, the sensors monitor the condition of rotational equipment, the main malefactor in production shutdowns, reportage temperature and overall vibration every five minutes. Engineers are able to monitor changes in the vibration frequency, wirelessly, empowering the early identification of potential problems, and implement pre-emptive condition monitoring as part of regular practice. Rendering to Apportion, the cost is up to 70 per cent less than a wired solution and there are none of the allied possibilities of redundant plant shutdowns. Powering wireless sensor systems consuming vibration energy ingathering empowers low cost installation and maintenance of continuous on-line condition monitoring of plant and machinery.

c)Industrial Implementation: Wireless sensor networks are being primarily piloted in noncritical industrial monitoring applications including predictive maintenance and condition-based monitoring to enable day to- day machinery monitoring and automation of data collection In fact, condition-based monitoring often supplements predictive maintenance by acting as an early warning system. Predictive maintenance applications benefit from automation of the traditional manual process for collecting machine condition data and more frequent sampling, while condition-based monitoring applications benefit from more sensing points. General Cable replacement of wired sensors to reduce cost can be found for temperature sensors [9] and vibration sensors [10]. In these deployments, the sensors support predictive maintenance for machinery by sending sensor measurements to a central database that is later analyzed. Specific applications of wireless sensor networks include motor analysis and machine tool performance.

Wireless sensor networks enable condition monitoring systems for small electric motors [11] as well as wire replacement for traditional motor vibration monitoring sensors. In addition, wireless sensor networks enable new in-situ motor analysis opportunities previously not possible with wired sensors including agent based steady-state motor analysis and onboard oil analysis. Applications to machine tool monitoring include temperature measurement sensors for end-mill inserts and vibration-based condition monitoring for tool breakage. In particular, vibrations in machine tools reduce tool life, are a result of dynamic loading, structural element flexibility, cutting conditions, and spindle characteristics, and are often characterized by stability lobes describing regions of "safe" machining with respect to chatter and surface finish. Wireless sensor networks enable new opportunities not possible with wired sensors such as multisensory data fusion methods to estimate tool wear using vibration monitoring of the spindle and/or work piece. In additi, wireless sensing of current, voltage, and acoustic emission signals is also reported.

III. RSA ALGORITHM

The Rivest-Shamir-Adleman (RSA) algorithm is one among most accepted public-key encryption method. RSA uses message attachments which are issued by the certificate authority. Attachment contains a sender identity and encryption keys these secret code enables security over the sending information. This is an energy efficient method to factor large number and avoids the confusion over the mismatches happening in the earlier technique. RSA scheme is tested in matlab, microcontroller like AVR, 8051 etc.

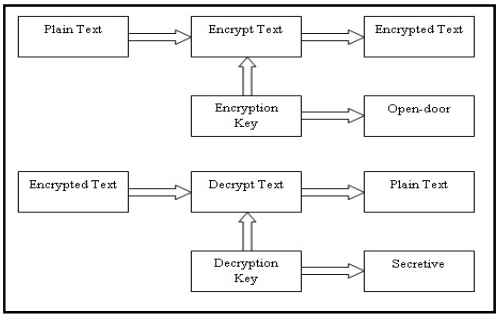

Figure.4 Asymmetric encryption and decryption

Encryption and decryption is done via a publicly known algorithm which makes use of a key. The message is encrypted with public key and can only be decrypted by using the private key. The encrypted message cannot be decrypted by anyone who knows the public key. Thus secure communication is possible. The efficiency of such keys for encryption decryption is considered here.

An RSA algorithm involves three steps:

- *Key Generation*: Public key (which is published) and a private key (kept secret) are attached with the message. The keys are generated in a way that conceals their construction and makes it hard to find the private key by only knowing the public key.
- *Encryption*: Public key is used to encrypt the message.
- *Decryption*: Person who is addressed in message can decrypt the message using the private key.

IV. KEY GENERATION ALGORITHM

It involves the generation of a public key and a private key. The public key is known to everyone. It is specifically used to decipher messages. Private key is used to decrypt the messages that are encrypted using the public key. The message or the data is encrypted using the public key. Encryption involves converting the message into a coded format. The public key is accessible to everyone and anyone can encrypt the message.

The various steps of RSA algorithm are:

- Choose two very large random prime integers: h, f
- Compute m and φ(m):
  m=h*f
  φ(m) = (h-1)(f-1)
- Choose an integer a, $1 < a < \varphi(m)$ such that:
  gcd (a, φ(m))=1(gcd – greatest common divisor)
  Find the multiplicative inverse of e modulo φ, i.e., find b, where $1 < b < \varphi(m)$ so that:

$ab \equiv 1 \pmod{\varphi(m)}$

The public key is (m, a) and the private key is (m, b), the values of h, f and φ(m) are private, a is the public or encryption exponent and b is the private or decryption exponent.

Encryption: The cipher text C is found by the equation

'$C = M^a \bmod m$' where M is the original message

Decryption: The message M can be found from the cipher text C by the equation '$M = C^b \bmod m$'.

1. The RSA algorithm works as follows:
2. Select the prime integers h=11, f=3.
3. m=h*f=33; φ(m)=(h-1)(f-1)=20
4. Choose a=3
   a. Check gcd (3,20)=1
5. Compute b=7
   a. $ab \equiv 1 \pmod{20}$
6. Therefore the public key is (m, a) = (33, 3) and the private key is (m, b) = (33, 7).

Now we want to encrypt the message M=7

$C = M^a \bmod m$

$C = 7^3 \bmod 33$

$C = 343 \bmod 33$

$C = 13$

Now the cipher text C has been found. The decryption of C is performed as follows.

$M' = C^b \bmod m$

$M' = 13^7 \bmod 33$

$M' = 62{,}748{,}517 \bmod 33$

$M' = 7$

After the message has been encrypted and decrypted the final message M' is the same as the original message M.

V. CONCLUSIONS

This paper is focusing on monitoring gas leakage by wireless network sensors in oil, gas, pipelines, operation, industrial organization, and vibration-energy ingathering. In accumulation, enlarged dependability is reached by incapacitating faulty intermediary node let down; get the most out of node battery life, and lengthening network lifetime. In the future, more thorough analysis of other aspects of the model, containing security, will be done. In addition, performance optimizations will be considered for various sensing and monitoring applications which generate

different network traffic conditions and varied Quos requirements. The following issues will be considered for future work:

- Varieties of wireless sensors are commercially available from different vendors. These sensors need to be surveyed so that an appropriate off-the shelf sensor can be chosen for pipelines monitoring. While choosing wireless sensor many factors need to be considered such as energy scavenging module, maximum transmission distance, and ambient conditions.
- More investigation is required concerning routing the sensor (slave) information to the sink (master) node.
- Given the developed reliability model, to allocate target reliability to the overall system a top-down approach for reliability allocation can be deployed.
- Fault tree analysis (FTA) may be used to develop system failure mechanisms and the reliability analysis.
- Non-linear structures of pipelines may be considered. This requires revised system design and the reliability modeling.

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