



# **An Analysis of Emergency Awareness Wireless Sensor Network for Internal Conditions**

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## **ABSTRACT**

In this modern epoch of Information technology we do have confrontations and dares up with scores of unusual sorts of tragedies or urgent situations from different state-of-affairs perspective and mostly in the enclosed or internal surroundings. Awareness and retort to such abrupt tragedies is decisive sequentially to look after possessions together with an individual existence. We analyzed here an anticipated emergency awareness/response system which is trouble-free to put into practice and is able to make the individuals/users aware about the urgent situation in an assortment ways, for instance, computer screen pop-ups, through SMS and etc etc. In view of the facts of such suppleness and facets of alerting, small size, economical outlays and straightforward employment, ‘WSN’ based emergency response/awareness systems opted to be the promising and best favorable systems in the coming prospects. Here we give you an idea about an anticipated design of past for such awareness system utilizing temperature sensors as a verification of model.

## **Keywords**

WSN, ZigBee, Networks, Sensors

## **1. INTRODUCTION**

Currently is an era where we dare to confront tenaciously with progressively more numerous sorts of disasters and urgent situations in our surroundings. One stunning case which is being notable is the handgun aggression and which has overwhelmed our academic institutions and society in a similar way. On top, such establishments with underprivileged infrastructure may possibly lack of such aptitude to play down hammering of possessions, property and an individual life in times of expected calamities. Therefore the key idea/aim of this projected concept was to devise a wireless network bring into play all together Zigbee and 802.15.4 to react to any urgent situation and notify the right persons in a sensible well-times and economical sound approach. A wireless sensor network is a wireless network, comprises self-governing devices/hardware that is uniformly distributed and exercising sensors with an aptitude of keeping an eye on the objective or ecological circumstances. For example temperature, pressure, motion, sound, vibration or toxins at an assortment of diverse places [17][19]. Each and every node in a sensor network is characteristically outfitted with a radio transceiver or by means of other wireless communications hardware’s, an undersized microcontroller, and an energy supply in form a battery [17]. The predictable size of a solitary sensor node can contrast from shoebox-sized to the size of grain of dust, with similarly variable cost starting from hundreds of dollars to a only some cents, relying on the sensor size and the intricacy and density mandatory for particularly those individual sensor nodes [18]. Size and cost constraints are directly and indirectly linked and influenced by the constraints on memory, energy, computational speed and bandwidth resources [19].

## **2. VACANT EMERGENCY SYSTEMS**

The Emergency system by a well know supplier has been deployed names as “Wireless Emergency Notification System” exercises proper text messaging to give notice to the inhabitants on site about an urgent situation or crisis. Such texting scheme is the utmost blessing for site-wide notification elucidation implementations as pointed out in [2]. The connectivity protocols of this particular system to the Carriers guarantee deliverance in a sensible approach even at some point in phone network surplus comparable to the [2] scenario. It has a towering consistency pace for the reason that they have moved out through an appropriate course of action together with all carriers and its outlays are extremely minor while putting forward the service to unrestricted consumers. It can be set off by means of a mobile device by texting to an acknowledged number. Nearly all systems depend on web access or phone call to kick off a warning. In this system an official individual decides to alert, write the text and propel it. The system attempts every five seconds, until further notice, till the text is conveyed. It has also the ability to trail each text with a deliverance acknowledgment and following report. It has also an additional facet referred as an “Imaging and Video Delivery System” used to endow the on-site group of people the facility to propel snaps and video to on-site law enforcement [2]. The concern institute/establishment routinely updates their websites with latest events/notifications/alerts all together with a variety of listed measures to be considered in urgent situations [1] so-called a reflexive crisis retort and for this reason it doesn’t contend with others in regards to its time effectiveness. All workers and apprentices of the concern establishment will have their official email addresses. They will receive alerts through that email address from the system/server]. The institute/establishment will has time-honored also a toll-free local telephone number to receive the alerts accordingly. The institution has chosen a set-up of positions and workers within to take delivery notifications and sequentially, report the inhabitants by means of a radio based notification system. On behalf of the assessment of the that particular institution emergency reporting system website [2], it will make the system to take approximately 4 minutes to issue an alert subsequent to the crop up tragedy, plus 2 minutes more to notify all the registered users with that system. Here response time is current load dependent such as an emergency nature and the swift/rapid way it has been identified by system. It has been recommended on basis of data that the typical response time is 3-4 minutes to such emergency. Studies are in progress to trim down such response time to as short as possible [3]. There are some fundamentals facets need to delve into prior to any research on such systems. a) Sensors efficiency to become aware of an urgent situation. b) Communication hindrance between information sensing and reporting from the individual sensor to the focal point. c) Hazard substantiation delay upon the emergency has been identified. d) By and large notification



delays to end consumer.

### 3. RELATED CONTEMPORARY PROPOSED MODEL

The anticipated scheme made use of open hardware for its proposal implementation. In particular the researchers had it in mind to bring into play Arduino's Xbee elucidation to carry out a likelihood exploration. The motive behind doing so is as well to have an economical and a vigorous model. Their concluding aspiration is for the concern development to bring into play Personal Computers as the 'sink' for the purpose to gather data from a range of sensors and endow them in a user-friendly manner. The gathered data can subsequently be accumulated properly too. Software's can be programmed for reading the messages or alerts in time of emergency. IEEE 802.15.4 standard put forwards a realization for the lower or subordinate layers, the PHY and MAC meant for an archetypal Wireless Sensor Network as conferred in [13]. 802.15.4, mulls over primarily on economical, low-speed communication among devices. The indispensable IEEE 802.15.4 structure classifies a communication range of 10-meter with having an utmost 250kbits/s transfer rate. For ZigBee specification, it is the origin, which in addition endeavors to put forward an inclusive networking way out by mounting the upper layers which in other words referred as an interface with the IEEE 802.15.4 MAC [7].

#### 3.1 802.15.4 Standard

The structure of this protocol comprises no more than PHY and MAC layers [13].

##### 3.1.1 Physical layer

This layer is responsible for the data transmission service, over and above the interface to the PHY layer managing unit. It deals with the physical Radio Frequency transceiver and carries out the task of choosing the channel all together with the functions management of energy and signal. It is accountable for the below mentioned undertakings:

- i. Radio Frequency transceiver initiation and de-initiation.
- ii. Energy detection (ED) inside the contemporary channel
- iii. Link quality indicator (LQI) for acknowledged packets
- iv. Clear channel assessments (CCA) for carrier sense multiple access with collision avoidance (CSMA-CA).
- v. Frequency selection of Channel
- vi. Transmission and reception of data.

##### 3.1.2 Medium access control (MAC) layer

It is accountable for point-to-point deliverance among nodes. In addition to the data service, it put forwards a management interface and manages entrée to the physical channel and network beaconing by itself. It in addition has power over frame corroboration; guaranteed time slots (GTS) and controls the relations of nodes.

The sub layer of MAC controls all access to the physical radio channel and is in charge for the subsequent responsibilities:

- i. Creating network beacons, incase where the device is a controller
- ii. Coordinate to network beacons
- iii. Sustaining PAN association and disassociation

- iv. Sustaining device safety measures
- v. Bringing into play the CSMA-CA method for channel access
- vi. Managing and upholding the GTS method
- vii. Endowing an unswerving link between entities of two peer MAC

#### 3.2 ZigBee

It is a design for a group of towering rank communication protocols employing undersized, low-power digital radios based on the IEEE 802.15.4 standard in regards to Wireless Sensor Network. These small devices are capable to be interfaced to the PC or some other end points [8]. They need a particular ZigBee modem just for the motive to hook up to client explicable digital interface. This Modem will be connected to the PC USB port and will accumulate on a COM port or in other words a standard serial port. The stipulations of ZigBee for devices to be in touch with each other utilizing a Star, Mesh or Tree topology. Consequently, the concern modems can be brought into play to converse to scores of other ZigBee devices and they will be in a position to prefer the device they want to talk to irrespective of time constraints. We have two ZigBee modules/units in particular, series 1 and series 2. The Series 2 Modem is considered necessary to talk/converse to the devices of Series 2. It also put forwards an innovative trait referred as mesh networking to set asides PC's to talk/converse to the out-ranged or outcast devices by means of communication with the devices in between them. [11].

The key objective of such design of emergency system is to have an economical sound Wireless Sensor Network. At this time Bluetooth recommends diminutive personal area coverage, On the other hand it doesn't have the qualifications of Tree or Mesh networking likewise ZigBee. The Bluetooth is also a specification of an IEEE 802.15 WPAN with having a range of an unlicensed frequency band and of 2.4-GHz. Bluetooth also make use of low power minute type aspects/features. [15] Has described the technical dissimilarities between Bluetooth and ZigBee.

The specifications of IEEE 802.11 standard endows with MAC and PHY layers having the ability to be brought into play for a successful indoor communication in excess of more than a few hundreds meters. At this juncture we put side by side IEEE 802.11 and 802.15.4 wireless standards specifications with highlighting the PHY layer [15]. And [16] can be referred as an Interfacing of 802.15.4 to 802.11.

### 4. STRUCTURE/CONFIGURATION OF WSN NETWORK:

There are two individual operation modes of wireless networks. i) Ad-hoc and ii) infrastructure/fixed. Infrastructure or fixed one by and large has a base-station which takes action as a central coordinating or harmonization node. Typically the base-station is responsible for enabling access to the wireless networks, intranet, or internet. The drawback of this operation mode is that it is a central point of breakdown. Incase of its failure, the whole network won't be able to communicate [15]. A protocol for endowing a hierarchical organization with Wireless Sensor Networks has been recommended in [14]. In a different way from beforehand anticipated elucidations, a protocol, named clique clustering (CC), takes account of in its maneuver a reliable method for getting by with malfunction or elimination of node. Exclusively, the network is divided into clusters known as cliques. A well-organized method for constructing a coupled



backbone or strength along with the clique clusters is afforded. Clustering, backbone development and upholding are from top to bottom restricted in a clear-cut logic that simply nodes actually close to a fading node are drawn in the process of reconfiguration. Here 802.15.4 is brought into play in view of the fact of its stumpy power rations. At this point the ZUXPProXR Zigbee Interface Module has been employed for the main device objective of attaining the aptitude to interface Zigbee devices to a Personal Computer (PC). Such interfacing facilitates to put in more relays to this device and UXP (Unit Extension Port) makes us to include Input/Output extension Modules/units to the Device expansion ports (DXP). This Device operates in a way like it is unswervingly linked to the Serial Port of a Personal Computer. The ProXR series controller put forwards wireless serial communications, obliges no more than a 12VDC Power source. Once power-driven up, then onwards the relay controller hangs around for a command, comprises of a hardly any bytes of data, typically flanked by 2 and 6 bytes. And can propel commands to triggered relays, disengaged relays, have power over the entire relays at simultaneously, in addition there is also the possibility of sending such commands that notify a relay to switch on for a only some seconds, minutes, or hours [11].

## 5. SENSORS

Characteristically sensor node is also referred as a 'mote'. It is a WSN having the aptitude of congregating the sensory based information, dealing out and communicating with further linked nodes surrounded by the concern network [20]. Inside the sensor e do have a microcontroller responsible for carrying out operations of data processing and manages the operations of additional components/units within the sensor node [5]. These microcontrollers are extremely well-matched for sensor nodes [4]. Nearly all the sensor nodes take advantage of the ISM band for availing the facets of free of charge radio, an enormous spectrum provision and comprehensive accessibility. The communication based on RF is the most pertinent type of communication that is on top form to nearly all of the applications of WSN [20]. The WSN draw on the communication frequencies in between about 433 MHz and 2.4 GHz.

From the energy point of view, the most significant classes of memory are micro-controller on-chip memory and FLASH memory as well. Off-chip is hardly ever brought into play. Flash memories are employed for the reason of its economical and storage aptitude [20]. Batteries or Capacitors are utilized to store the power. This in other words its is the core source for providing the power to sensor nodes. It is also feasible for the power sensor to make use of alternatives or different power sources for example wind, solar power [21].

### 5.1 Temperature Sensing

Temperature sensing has been used a sort of parameter or as a case study to give you an idea about the soundness of Wireless Sensor Networks in an emergency response systems area. [23] Zigbee Wireless Temperature Sensor, WML-WSO-04002 has been brought into play for the purpose of temperature sensing. Here the sensor of temperatures turns out a voltage that is relative to the temperature of the device die. Such voltage is brought in as one of the inputs to the "Analog to Digital Converter" multiplexer [22]. As soon as the temperature sensor is chosen to be the Analog to Digital Converter input supply and the Analog to Digital Converter sets off a conversion, the consequential Analog to Digital Converter output code onwards will be rehabilitated into temperature degrees. As soon as the temperature begins to rise due to fire inside the room, will automatically boost the sensors voltage in this perspective.

Just for the reason to uncover the ambient based temperature, the

temperature raise up just because of self-heating be obliged to be taken off from the upshot. There are scores of aspects that put in to the value of self-heating of device. Voltage of Power supply, operating frequency, the thermal indulgence, package distinctiveness, device mounting on the PCB, and airflow over the package. The increase in temperature can be measured by multiply the dissipation of device's power by the package thermal dissipation constant, as a rule called  $\theta_{JA}$  [22]. There are lots of ways to measure the temperature increase due to self-heating. One way is to commence a conversion quickly once power applied to the device to acquire reading of a cold temperature, and subsequently calculate once more later than about a minute of maneuver, to obtain a hot temperature reading. The sensors of temperature generate an output of voltage which is comparative to the unconditional temperature of the die within device.

Such voltage of sensors is not unswervingly assessable outer the device other than it is vacant as one of the inputs of the ADC multiplexer, setting aside the ADC to compute the voltage and bring into being an output code which is comparative to it.

In this scenario a WML-WSO-04002, Zigbee™ Wireless Temperature Sensor has been utilized. Such sensors have an extensive range of applications and are intended for supervision unsympathetic surroundings [23]. The temperature range of the sensors is flanked by  $-40^{\circ}\text{C}$  to  $+110^{\circ}\text{C}$  with a precision of  $\pm 0.3^{\circ}\text{C}$  at  $25^{\circ}\text{C} \pm 1.5^{\circ}\text{C}$  transversely jam-packed range and also has decree of  $0.01^{\circ}\text{C}$ . The sensor is self-possessed of Stainless Steel and Acetyl and having weight 300g. The sensor maneuvers in the range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ . It is capable to be effortlessly interfaced with Arduino systems and formulate an end-to-end temperature sensing Wireless Sensor Network.

## 6. EMERGENCY AWARENESS SYSTEM APPLICATIONS:

### 6.1 Autonomous or Self-Directed early on recognition

Self-directed early on recognition or detection of an urgent situation is the most important approach of diminishing smash ups or life menacing actions. The emergency recognition dilemma has been represented as a node k-coverage setback " $k \geq 1$ " in WSN [4]. The centralized algorithms of constant-factor are brought into play to work out such node K problem.

### 6.2 The Renewable or Self-Powered Energy System

By way of contemporary progressions in substitute energy the sensors brought into play in the system is able to be solar powered. And such systems have the aptitude of promoting out-of-doors sensing and in the house sensing where there are colossal skylights or unlock regions by means of way in to sunbeams. Power burning up is a quandary at this time being raised in Wireless Sensor Networks. The sensors operating on solar power can endow a value to Wireless Sensor Networks for emergency retort by protracting the existence of such sensing nodes. Investigational consequences have confirmed that convinced archetypes akin to the MPWiNodeX, can deal with concurrently energy from wind, Solar and for charging follow-on in a roughly uninterrupted maneuver of the weigh up router of ZigBee network. Moreover, the energy searching practices twofold it to as sensors, giving up data on the amount of solar emission, wind speed and water flow.

### 6.3 Digital Image intimidation authentication System

Wireless Sensor Networks can be placed as a sensor with a





camera other than of a sensor temperature, to witness firm vicinity inside the building. This can be subsequently brought into play as a supervision network. On hand delve into studies confers optimizing the algorithms of image segmentation on behalf of an image facets devoid of manual intrusion [5]. These practices work out image properties such as typical edge incline power, inter- vs. intra-cluster detachments utilizing aspects of image, and color wholesomeness of consequential sections, to instruct a neural network that address these to ground-truth cataloging on the satisfactoriness whether it is fine or terrible of the elucidation in the ensuing segmentation. There are tactics that carry out tremendously glowing by appropriately envisaging the most favorable strictures of image segmentation algorithms brought into play. The Images is able to be enhanced by means of computer that is observed or viewed by human operator so that contraband becomes visible in severe distinction to its background so that individuals can straightforwardly identify it.

From images point of perspective, the system will be obliged to involuntarily practice such data to improve its superiority, section objects of attention and afterward exercise a number of characteristics to distinguish the ensuing areas. Nevertheless, for scrutiny, if the data is a one-dimensional signal or spectra, the undertaking engrosses pattern harmonizing where test spectra are harmonized with acknowledged patterns.

## 7. ANALYSIS

At present we don't have any or less emergency notification/awareness which is in particular modeled for aforementioned urgent situations. But this technology has been brought into play in other sorts of disaster state of affairs such as forest fire detection, navigation throughout disaster circumstances, wireless internet information system for therapeutic retort in disasters and several others. The shortcomings of such system will be innate from the ZigBee and IEEE 802.15.4. An additional setback in retort to crisis state which enormously rely on the legitimacy of the danger or state of an authentic tragedy in which emergency service can incise outlay by not retorting to counterfeit tragedies and thus their time can be utilized in better manner to deal with authentic crisis.

## 8. CONCLUSION

So far we have delve into the studies so it is possible or doable to assemble a Wireless Sensor Network for emergency awareness warning employing the IEEE 802.15.4 and Zigbee. Likewise there is an assortment of sensing applications which can be fashioned by brining into play 802.15.4 MAC and PHY all along with stack of ZigBee. And it has the prospective to trim down the response/retort/notification time in an economical manner. The system is full-bodied and well-organized techniques can be integrated to bear out the risk by toting up a number of supplementary alternatives to the sensors to help them out to diminish counterfeits situations.

The projected emergency system right now has been focusing on the fire detection feature which happens frequently in several establishments. This system has still the gaps and space to be fashioned and delve into more and to develop or craft a full fledged system to detect other urgent situations like gas pipeline leakages and many more.

## 9. REFERENCES:

- [1] <http://www.siuc.edu/emergency>
- [2] <http://www.inspironlogistics.com/>
- [3] <http://www.facilitiesnet.com/>
- [4] "H. Mohammed & Majid", "Forest Fire Modeling and Early Detection using Wireless Sensor Network" in Ad-Hoc & Sensor Wireless Networks, Vol 7, Philadelphia, Old City Publishing, 2009, pp. 169-224.
- [5] "Morais" Sun, wind and water flow as energy supply for small stationary data acquisition platforms" in Computers And Electronics In Agriculture, Vol 64, 2<sup>nd</sup> issue, Oxon England: Elsevier Sci LTD, DEC 2008.
- [6] "M. Singh & S. Singh", "Image Segmentation Optimisation for X-Ray Images of Airline Luggage" in CIHSPSZOW-IEEE Intl Conference On Computational Intelligence for Homeland Security and Personal Safety Venice, Italy, 21-22 July, 2004, pp. 10
- [7] Wikipedia contributors Wikipedia, The Free Encyclopedia "IEEE 802.15.4-2006".
- [8] Wikipedia contributors Wikipedia, The Free Encyclopedia "Zigbee".
- [9] <http://www.61ic.com/fanga/wxtx/ZigBee/200703/12494.html>
- [10] <http://www.techworld.com/mobility/features/index.cfm?featureid=1261>
- [11] [http://www.controlanything.com/Merchant2/merchant.mvc?Screen=PROD&Product\\_Code=ZUXPPROXR&Category\\_Code=UXP](http://www.controlanything.com/Merchant2/merchant.mvc?Screen=PROD&Product_Code=ZUXPPROXR&Category_Code=UXP)
- [12] IEEE 802.15.4e Standard on Wireless MAC and PHY Specifications for Low-Latency MAC for WPANs.
- [13] IEEE 802.15.4 Standard on Wireless MAC and PHY Specifications for Low-Rate WPANs.
- [14] "Basagni, Petrioli, & Petroccia", "Fail-Safe Hierarchical Organization for Wireless Sensor Networks", MILCOM 2007, PP:1-7.
- [15] <http://janmagnet.files.wordpress.com/2008/07/comparison-ieee-802-standards.pdf>
- [16] Sofie Pollin, Mustafa Ergen, Antoine Dejonghe, Liesbet Van der Perre, Francky Catthoor, Ingrid Moerman, Ahmad Bahai", "Distributed cognitive coexistence of 802.15.4 with 802.11
- [17] "Römer & Friedemann", "The Design Space of Wireless Sensor Networks" in IEEE Wireless Communications, vol. 6, no.11, (December 2004).
- [18] "T. Haenselmann", "Sensornetworks" in GFDL Wireless Sensor Network (April 2006).
- [19] "Hadim & Nader", "Middleware Challenges and Approaches for Wireless Sensor Networks" in IEEE Distributed Systems Online, vol 3, no. 7 (2006).
- [20] "Y. Xu, Heidemann, Estrin", "Geography-informed energy conservation for ad-hoc routing" in Proc. Mobicom, 2001, pp. 70-84.
- [21] Sinha & Chandrakasan", "Dynamic Power Management in Wireless Sensor Networks" in IEEE Design & Test of Computers, Vol. 18, No. 2, March-April 2001.
- [22] AN103 Datasheet, Using The On-Chip Temperature Sensor, Silicon Laboratories, 2003.
- [23] [http://www.wirelessmeasurement.com/index.php?option=com\\_docman&task=doc\\_download&gid=2&Itemid=63](http://www.wirelessmeasurement.com/index.php?option=com_docman&task=doc_download&gid=2&Itemid=63).