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Internet of Underwater Things: Underwater Acoustic Speech Processing, Real Time Sea Pollution Monitoring, Oceanographic System and Monitoring Sensible Parameters in Deep Sea for Underwater Autonomous Vehicle and Disaster Management

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ABSTRACT: Intercontinental Submarines cannot communicate in deep sea and accomplish its purpose unless the accuracy of the signal is tested under the diverse acoustic sound waves, the submarines may conversation. The various underwater noise signals are modulated into message signal like blue whale upto 240dB; offshore seismic surveys upto 180dB, Peek rock movement up to 180dB could also negatively impact the transmission. The capability of reducing the disturbance signals by the ANFIS based band-pass filter which obtains the actual message of underwater submarines. The real time embedded module constructed with three systems. Firstly, Implementation of Sensor network for analyzing the water pollution in ocean. Secondly, Oceanographic system for analyzing the number of ocean reflected signals visible by global positioning data. Thirdly, Disaster Management System (DMS) measuring the sensible parameters (like temperature and pressure) of deep sea. The implementation of Internet of Things like a web tool developed for dynamically adjusting and controlling the behaviour of submarines and communicates with each other and easy to interact with the machine using real time information with high encryption standard.

KEYWORDS: PIC Development Board, Global Positioning System, Audio Device, Piezo Vibrator, GSM Modem, Ultrasonic Sensor, Turbidity Sensor, Temperature sensor, Pressure Sensor, PH Sensor, Inductive Proximity Sensor, Motor, Buzzer.

I.INTRODUCTION

Deep Sea acoustic communication is a technique of sending and receiving message below water. There are several ways of handle such communication but the most common usage is hydrophone. Deep Sea communication is difficult due to aspects like multi-path multiplying, time changes of the channel, small applicable bandwidth and strong signal filtration, especially over long distance of ranges. In Deep Sea communication there are low data rates compared to terrestrial communication; after all underwater communication uses acoustic waves instead of electromagnetic waves. Deep Sea acoustic communications are mainly consequences by path loss, noise, multi-path, Doppler spread, and high and variable propagation delay. All these kind of aspects designate the temporal and spatial variability of the acoustic channel, and make the available bandwidth of the Underwater Acoustic carrier limited and dramatically dependent on both range and frequency. Most of the system operate over several 10km may have a bandwidth of only a few kHz, while a short-range system operating over several 10m may have more than a 100kHz bandwidth. In both cases these aspects lead to low bit rates. Moreover, the communication range is dramatically decreased as compared to the terrestrial radio carrier. Deep Sea sound wave communication links can be classified according to their range as long, medium, short links. Acoustic links are also roughly escalation into vertical and horizontal respectively. According to the direction of the sound ray, especially with respect to time dispersion, multi-path escalation, and delay changes.

II. LITERATURE SURVEY

In this article, Frequency Spreading Doppler Scaling Compensation in Underwater Acoustic Multicarrier Communications, In underwater acoustic (UWA) communications, the mobility of communicating vehicles results in a change of the time scale in the received signal. This is called Doppler scaling. Doppler scaling, although small (usually

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1%, or smaller), impacts the receiver performance significantly, if uncompensated. This paper suggests a novel method for compensating Doppler scaling in filter bank multicarrier (FBMC) systems. We show that the method of frequency spreading that have already been applied to the design of digital filters can be applied to each subcarrier in FBMC systems to compensate the impact of Doppler scaling. This novel approach compensates for Doppler scaling with a very small addition in the complexity [4]. Performance Analysis and Optimal Design of Multichannel Equalizer for Underwater, Adaptive equalization is a widely used method of mitigating the effects of multipath propagation and Doppler spreading in underwater acoustic communication channels. While the structure of a multichannel equalizer and least-squares-based adaptation algorithm are extensively used in practice, little is known in how to choose the number of sensors, separation between them, and lengths of the constituent filters such that the equalization performance is optimized. This paper studies the problem of optimal multichannel equalizer design in the context of time-varying underwater acoustic communication channels [5]. The Internet of Things is already a global phenomenon that is going to change our everyday life as much as our life was already revolutionized with the global use of Internet itself. Internet of Things can be seen as billions of connected devices designed to offer new services in every aspect of our lives. These devices interact and communicate directly with other devices, sensors, actuators, the environment, etc. As new IoT devices and applications are spreading across the world in every domain every day, and satellite connectivity allows connected devices to wirelessly communicate over the ocean to ships at sea (tracking and monitoring boats and containers), there is one place where IoT is not present – the underwater world. Creation and development of this new Internet of Underwater Things ecosystem is needed to solve big issues. All these technologies have strong drawbacks: it is hard to reach more than a few feet into the depths, a lot of power is needed to communicate anywhere, and the information-carrying capacity of low frequencies is quite low. Acoustic communication is another solution, as sound is able to travel vast distances under water depending on their frequency (whale songs can travel tens of kilometres). But even with this technology, issues exist, such as managing the effect of multiple reflections from the depths and surface and the deep water environment vs. the shallow water environment [3]. A High-speed Digital Underwater Communication Solution Using Electric Current Method, The limitations of underwater acoustic communication have been intensively discussed. In this scenario, electric-current communication method is considered as a feasible solution to explore as an alternative to acoustic communication in case of short-range distance. Compared to underwater acoustic communication, electric-current communication method shows its advantages such as fast propagation, high band width and being not prone to noise due to mechanical movement. In this paper, a DSP based underwater modem using electric current method is designed, implemented and evaluated. According to the experiments, error-free communication is possible in a water tank with a data rate of 1Mbps [13].

III.PROBLEM DEFINITION

Unfortunately, most existing FIR filter fails where speech processing having degrees of non linearity and parameters variability and uncertainty of the mathematical model of the system, however FIR filter algorithm is simple stable easy tuning and high reliability. ANFIS based FIR filter method is better method of recognizing the complex and unclear Audio speech systems. Fuzzy rules can be evaluated from the human experience and knowledge about the system. Battery power is limited and usually batteries cannot be recharged, also because solar energy cannot be exploited.

Major challenges in the design of underwater acoustic are: The available bandwidth is severely limited, Channel characteristics, including long and variable propagation delays, multi-path and fading problems, High bit error rates, Underwater sensors are prone to failures because of fouling, corrosion. The objective is Under water communication is difficult due to factors like multi-path propagation, time variations of the channel, small available bandwidth and strong signal attenuation, especially over long ranges. In underwater communication there are low data rates compared to terrestrial communication. To set neural network and fuzzy rules makes FIR filter reliable for the communication process having different degrees of non linearity’s & variation in coefficients. There is a need to deploy underwater networks that will enable real time monitoring of selected ocean areas, remote configuration and interaction with onshore human operators. Proper maintenance and operation of sensor systems is important for maintaining efficiency, reliability and reproducibility. Without this assignment, internet of things not possible that can be moves on very dangerous position or it may be useful for marine appliances.

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IV.PROPOSED SYSTEM

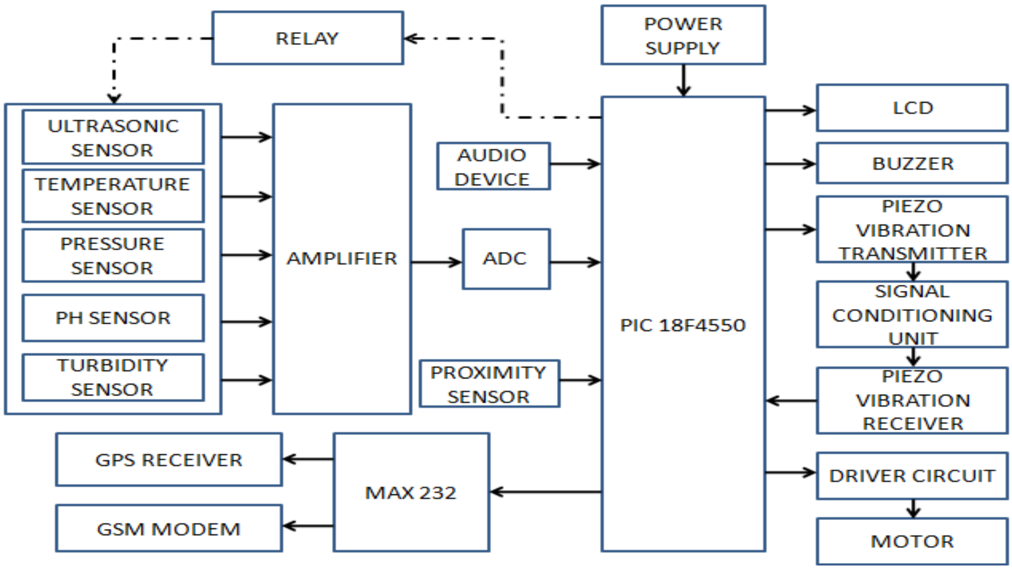

Fig 1 Main concepts of this project

With the aim of preventing such impossibility, it is proposed to develop a highly efficient and reliable of automatic underwater acoustic communications using piezoelectric based vibration sensor and, monitoring and controlling system for early detection of physical parameters like Temperature of ocean, Pressure of ocean, Ocean water flow and Depth of ocean by placing an embedded module along with sensor devices arrangement. This device is capable of distinguishing whether the underwater pressure and temperature varied or not, if the continuous oscillations occur in the underwater uses of sensor is detected, a safety application named ANFIS-FIR will be automatically control the noises in underwater like propagation velocity, absorption, multipath, path loss, ambient noise. Temperature and change in pressure which helps in eliminating the risk of travelling in under ocean. At the same time ensuring that does not pull to any dangerous. Fig 1 shows the main concepts of these projects. The most advanced method to control the highly complex and nonlinear behaviour of the closed loop temperature, is Fuzzy Logic and Neural Network. On the other hand, FIR filters are used in most of the linear and stable control application due to its functional and structural simplicity. This report presents a method of controlling the noises in underwater for communication and physical parameters like temperature, pressure by the combined action of both Neural Network and Internet of Things (IoT) for storing the sensor information in online. Systems gathering the information from online for the purpose of controlling the behaviour of underwater autonomous vehicle and easy to predict itself and also it is monitoring the underwater tsunami disaster occurrence. The research has been extended to show how far the system will help in preventing dangerous situation in underwater and to what extent this system will help in reducing the Indian economic loss incurred unnecessarily due to marine fatalities.

V.ANFIS BASED FIR BANDPASS FILTER

Kaiser window, that a trade off exists between the main lobe width and the side lobe amplitude. The main lobe width is inversely proportional to the N. An increase in window length decreases the transition band of the filter. However, the minimum stop band attenuation is independent of N and is a function of the selected window. Thus, in order to achieve prescribed minimum stop band attenuation and pass band ripple, the designer must find a window with an appropriate side lobe level and then choose N to achieve the prescribed transition width. In this process, the designer may often have to settle for a window with undesirable design specifications. To overcome this problem Kaiser has chosen a class of windows based on the prorate spheroid functions.

$$\beta = 0.1102(61.3) = 6.75526$$
$$D = 4.321$$

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$$N \geq 44.21$$

$$H(z) = z^{44} * \sum_{n=0}^{44} h(0) + [z^{n} + z^{-n}]$$

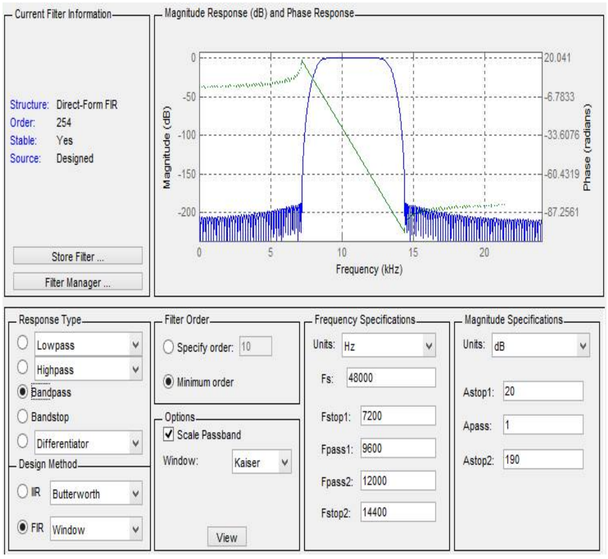

Fig 2Magnitude and Phase response of filter coefficients

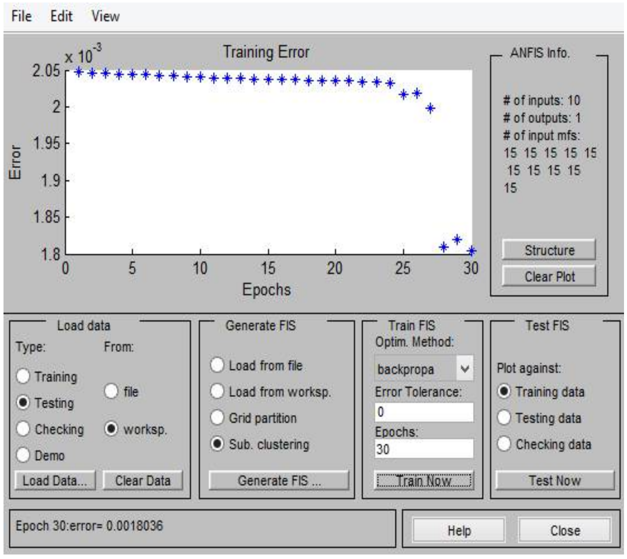

Fig 3 Training Error in Back Propagation algorithm

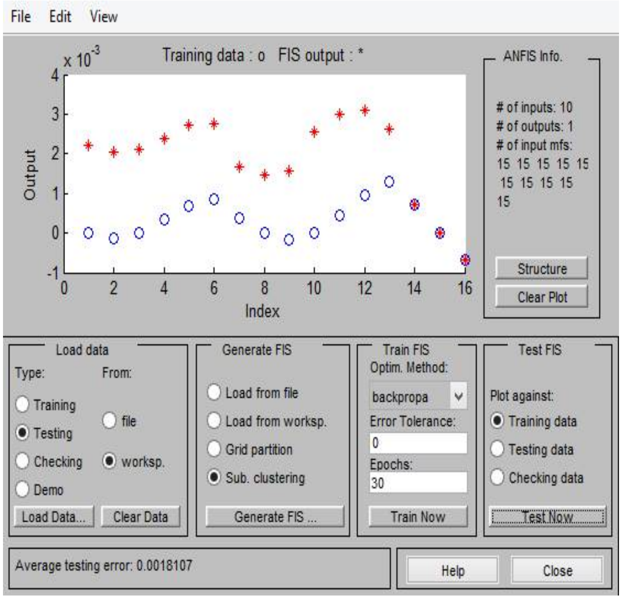

Fig 4 Training Data output using Back-Propagation

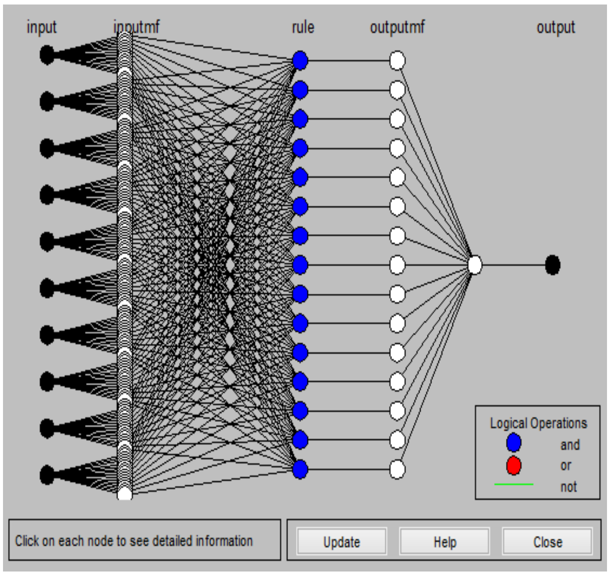

Fig 5 ANFIS Model Structure

VI. SYSTEM IMPLEMENTATION

PIC 18F Microcontroller: A microcontroller is a complete microprocessor system built on a single IC. Microcontrollers were developed to meet a need for microprocessors to be put into low cost products. Building a complete microprocessor system on a single chip substantially reduces the cost of building simple products, which use the microprocessor's power to implement their function, because the microprocessor is a natural way to implement many products.

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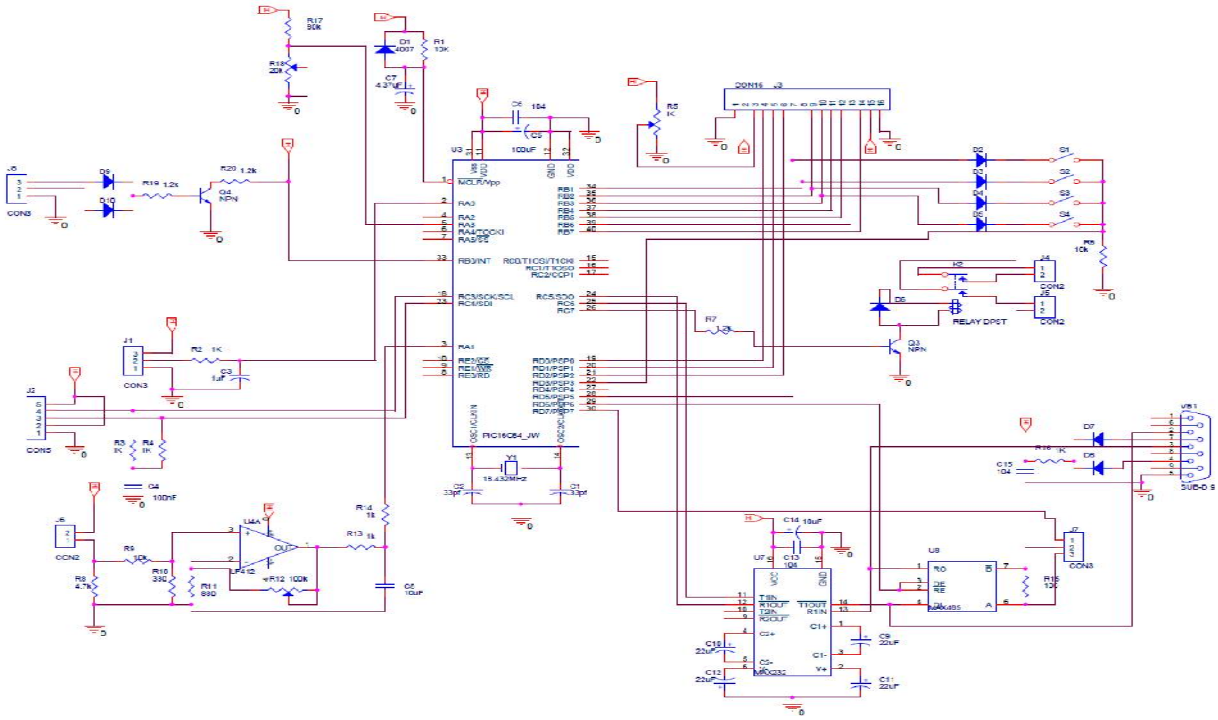

Fig. 6 Master Board Circuit

Underwater Test Tank: The Underwater Test Tank is thermally isolated from the external environment and filled with the water by using thermal isolation materials like Silica Fur, Silica Bricks etc. There are three sensors placed inside the tank. Temperature sensor DS18B20 is located at the middle of the tank from inside. The Pressure Sensor BMP180 is also located near the temperature sensor. The Turbidity Sensor TST-10 is also located inside of water tank for calculating the turbulence of water. The location of the sensors is selected so that the actual values of the parameters are read. Otherwise there may be error in reading the values. Fig 6 shows the master board circuit for this project.

Underwater Communication: The Underwater communication process is done through two devices. They are audio device is placed outside the tank. Digital Piezoelectric vibrator is located at the inside of the tank. The vibrator is used for converting the audio signal from the audio device into sound waves. That sound waves passing through underwater from transmitter to receiver. After that the received vibration is decode and recognize the original information. The location of the sensors is selected so that the actual values of the parameters are read. Otherwise there may be error in reading the values.

Inductive Proximity Sensor: Inductive proximity sensors are used for non-contact detection of metallic objects. Their operating principle is based on a coil and oscillator that creates an electromagnetic field in the close surroundings of the sensing surface. The presence of a metallic object (actuator) in the operating area causes a dampening of the oscillation amplitude. The rise or fall of such oscillation is identified by a threshold circuit that changes the output of the sensor. The operating distance of the sensor depends on the actuator's shape and size and is strictly linked to the nature of the material. This sensor is used for monitoring the current speed of motor.

Ph Meter: A pH Meter is a scientific instrument that measures the hydrogen-ion concentration (or pH) in a solution, indicating its acidity or alkalinity. The pH meter measures the difference in electrical potential between a pH electrode and a reference electrode. It usually has a glass electrode plus a calomel reference electrode, or a combination electrode. In addition to measuring the pH of liquids, a special probe is sometimes used to measure the pH of semi-solid substances. By using this sensor measure the Ph value of ocean.

SCR: A Silicon Controlled Rectifier (or Semiconductor Controlled Rectifier) is a four layer solid state current controlling device. This device acts as a switch that is cheaper than a relay and is able to handle the large power dissipation that is expected in industries. It consists of three layers namely Anode (A), Cathode (K) and Gate (G). It has three junctions and four layers.

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Buzzer: A buzzer or beeper is a signalling device, usually electronic, typically used in automobiles, household appliances such as a microwave oven, or game shows. It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a preset time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound.

Liquid Crystal Display: Liquid Crystal Displays (LCDs) have materials which combine the properties of both liquids and crystals. Rather than having a melting point, they have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered form similar to a crystal.

VII. SOFTWARE ANALYSIS

Neural Network Toolbox provides algorithms, functions, and apps to create, train, visualize, and simulate neural networks. You can perform classification, regression, clustering, dimensionality reduction, time-series forecasting, and dynamic system modelling and control. The toolbox includes convolution neural network and auto encoder deep learning algorithms for image classification and feature learning tasks. To speed up training of large data sets, you can distribute computations and data across multi core processors, GPUs, and computer clusters using Parallel Computing Toolbox.

Key Features

- Deep learning, including convolution neural networks and auto encoders
- Parallel computing and GPU support for accelerating training (with Parallel Computing Toolbox™)
- Supervised learning algorithms, including multilayer, radial basis, learning vector quantization (LVQ), time-delay, nonlinear autoregressive (NARX), and recurrent neural network (RNN)
- Unsupervised learning algorithms, including self-organizing maps and competitive layers
- Apps for data-fitting, pattern recognition, and clustering
- Pre-processing, post-processing, and network visualization for improving training efficiency and assessing network performance Simulink® blocks for building and evaluating neural networks and for control systems applications

Training Algorithms to handle the Training and learning functions are mathematical procedures used to automatically adjust the network's weights and biases. The training function dictates a global algorithm that affects all the weights and biases of a given network. The learning function can be applied to individual weights and biases within a network. Neural Network Toolbox supports a variety of training algorithms, including several gradient descent methods, conjugate gradient methods, the Levenberg-Marquardt algorithm (LM), and the resilient back propagation algorithm (Rprop). The toolbox's modular framework lets you quickly develop custom training algorithms that can be integrated with built-in algorithms. While training your neural network, you can use error weights to define the relative importance of desired outputs, which can be prioritized in terms of sample, time step (for time-series problems), output element, or any combination of these. You can access training algorithms from the command line or via apps that show diagrams of the network being trained and provide network performance plots and status information to help you monitor the training process. A suite of learning functions, including gradient descent, Hebbian learning, LVQ, Widrow-Hoff and Kohonen is also provided.

VIII.CONCLUSION

The lifetime of sensors for an underwater sensible parameters monitoring has been presented, allowing them to operate as autonomous measurement system for long period of time. The energy consumption of the system has been addressed and methods to reduce the energy consumption have been identified. Sensors are traditionally considered key enablers for Packet delivery ratio has been increased, while transmitting the data using cables. This paper deals, all phases of the practical development from scratch of a full custom sensor platform for an underwater monitoring IOT application. All aspects of the wireless and wired platforms are considered: reusability and flexibility, platform structure, optimization of the sensor node and gateway node, error recovery in communication and node operation, high availability of service, application server honesty and interface with IOT. The particular importance of IOT is low cost, fast deployment, long unattended service time.

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BIOGRAPHY

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