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UNIVERSAL INTELLIGENT SENSOR INTERFACE

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Abstract- This paper deals with the design of the universal intelligent sensor interface. Incorporating UISI makes the system highly flexible because it gives the freedom of either attaching or detchaing various types of sensor. The front end of the UISI can be configured as per the connected sensor with the help of the TEDS information and the firmware. There are two 10pin connector provided for analog and digital sensors. There are various types of analog sensors. The digital sensor also uses various interfaces such as I2C, SPI and RS232. The detail about the type of sensor and interface it uses is stored in TEDS.

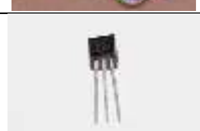
Index terms*:* UISI, conditioned sensor, unconditioned sensor, resistive sensor, SPI interface, I2C interface, RS232 interface, sensitivity, linearity.

I. INTRODUCTION

The low cost, energy efficient, compact, flexible sensor node for distributed sensing is becoming a new trend in field of agriculture, indoor monitoring, gas level monitoring etc. Flexibility and high level of integration are essential consideration for universal multi sensor based system design. Sensor interfacing, signal conditioning and efficient signal processing are the key components of the design. Smart sensor based instruments contain multiple sensors of different types and having heterogeneous front ends. Sensor signal processing becoming more critical due to new sensor technology adopted on demand to meet the requirement of power efficiency, compact, cost effective and high intelligence. The sensors plug and play technology, defined by IEEE 1451.3 is another important requirement in universal sensor system. which improves sensor measurement accuracy and ease-of-use. The plug and play technology decrease the data acquisition complexity and overall development cost. Various transducers are available on the market with a multitude of different interfaces to provide measurements of all kinds. Typical front-ends are voltage output, current output, capacitive and resistive outputs, and several digital interfaces such as RS232, I2C, SPI, frequency and bus based interfaces. The presence of such a large number of different interfaces often makes the design and the realization complex. Moreover, in order to design reliable and effective distributed monitoring systems, other fundamental aspects must be taken into account, such as the performance and the reliability of the sensors used for the system implementation. With the goal of promoting the development and adoption of smart transducers in instrumentation, the IEEE 1451 family of smart sensor interface standards defines a set of standardized interfaces for different categories of sensors and actuators. One member of this family, the IEEE 1451.4 standard, defines a mixed-mode interface that combines that traditional analog generic sensor signal with a digital interface that enables self-identification of the sensor for plug and play operation. This self-identification is provided by a transducer electronic data sheet (TEDS) is an electronic datasheet which defines identification information. There is very limited smart sensor available with (TEDS) facility, and the cost of such kind of sensor is also effectively high. The various environmental sensing transducer (gas, temperature, humidity, light, pressure, etc) available in the market having heterogeneous front end, signal conditioning, electrical and mechanical specification. So to interface different enormous multitudes sensors by incorporating IEEE1451.3 features in a common platform without increasing development cost and design complexity, universal highly reconfigurable sensor interface is essential. To interface heterogeneous sensors in a common platform system become bulky, power inefficient and least flexible. In order to overcome the above mentioned problem there is a solution known as universal intelligent sensor interface (UISI). With the help of this transducer with various topology such as conditioned, unconditioned, resistive, capacitive, current output and digital transducer can be interfaced using the same reconfigurable socket in a base. UISI has been developed to address the interfacing issues focused to the sensor used for environmental monitoring applications. In addition to configurable front end special priority has been given to the issues like short circuit protection, auto error detection and flexible wireless configurability. The main novelty of the system is that two sockets can be used concurrently to facilitate multiple sensor interfaces with common hardware, which further optimized Hardware optimization and development cost.

Table 1 frequently used environment monitoring

Sensor	Graphical Presentation	Sensor no	type	Required supply voltage	Nature of o/p
Carbon monoxide(CO)		**TGS 4161**	**Solid electrolyte**	**VH 5.0±0.2V DC**	**Unconditioned non differential voltage o/p**
Methane		**TGS 6810**	**Catalytic**	**3.0±0.05V**	**Unconditioned (Differential voltage)**
Hydrogen		**TGS 821**	**tin dioxide (SnO2)**	**VH 5.0±0.2V AC or DC** **VC Max. 24V DC only Ps≤15mW**	**Resistive**
Carbon monoxide(CO)		**MQ 7**	**SnO2**	**VH (high)5.0 VH(low) 1.4v AC or DC**	**Resistive**
Carbon monoxide(CO)		**TGS 5342**	**Electrochemical-type**	**Not required**	**0.7~1.4nA/ppm**
Oxygen		**SK 25F**	**galvanic cell**	**Not required**	**0 to 10 mv 0 tt 30% oxygen**

Light		**TSL235R**	**Semiconductor**	**2.7V**	**Frequency o/p**
Light(Color)		**ADJD-S371-QR999**	**Semiconductor**	**2.5 V**	**4 channel Digital o/p**
Infrared Thermometer		**MLX90614**	**IR sensitive Thermopile detector chip**	**5V**	**PWM output**
Humidity		**HH10D**	**Capacitive (C to Fconversion)**	**3V**	**Frequency (5 to 10 KHz**
Humidity		**SRhr233-C**	**Resistive**	**Typical 5V**	**1.9 to 920kΩ**
Barometric pressure sensor		**BMP085**	**MEMS based sensor**	**3.5V**	**SPI**
Barometric pressure sensor		**BMP280**	**MEMS based sensor**	**3.5V**	**SPI**
Temperature		**DS18B20**	**Semiconductor**	**3-5.5V DC**	**Serial Digital**
Temperature		**LM35**	**Semiconductor**	**4-30v DC 60μA**	**Voltage**

II. LITERATURE SURVEY

The interfacing circuitry for micro fabricated sensors plays an important role in determining the performance of transducer and thus is a crucial component in integrated micro system, which can be used in a broad range of application [4]. The healthy condition of the large scale structure is acquired by measuring a large number of parameters, so a lot of sensor is involved. There is various type of sensor and their output varies in large scale [2]. The configurable sensor interface employs Wheatstone bridge and switched capacitor topologies to efficiently perform signal conditioning for wide range of resistive and capacitive sensor [1]. The design and the realization of complex or distributed monitoring system are often difficult due the multitude of different electronics interfaces presented by the sensors available in the market [5]. The developed interface circuit provides technologies that both reduces the cost and time of SOC development and improve sensor system performance [3]. Today's sensor market is advancing toward the use of smart sensor in many applications. For a low-cost and low power sensor interface to be suitable for such a market, this interface must be capable of supporting a wide variety of smart sensor system [4]. The classical and some new measurement techniques have been applied to convert the non- voltage into voltage signal and amplify it to the input range of A/D converter [2]. The adaptive multi-sensor interface provides a platform solution with the flexibility crucial for implementing low-cost Microsystems of future [1]. Current applications require a combination of different sensors in single devices. Therefore, a sensor interface circuit that can receive input from various sensors is needed. To solve this problem, multi sensor interfaces or universal sensor interfaces have been introduced. This circuit can reduce the design cost where it can intelligently read and process different sensor application [7]. This paper describes a system and its internal architecture based on various gas sensors used for monitoring gas leakage in indoor and outdoor environment. This system is based on zigbee and PIC 18 LF 4620 micro controller unit. The node has the compatibility with the sensors and it can also be customized with other environmental sensors [9]. This paper presents the development of a versatile sensor platform used for autonomous data acquisition. The key advantages of the platform are its compact design, implemented onboard sensors, standard interfaces to connect application specific sensors and subsequently simple installation and low costs for the preparation of a measurement task. The main aim for the sensor platform was to design a versatile, easy to operate measurement system that is capable of recording measurement data for various measurement tasks simultaneously and synchronizing the input of multiple sensors connected [10]. This paper studies some key technology of multifunctional sensor signal reconstruction. The multifunctional sensor signal reconstruction problem, presented a multifunctional sensor signal reconstruction method based on B spline and the extended Calman filter. Simple systems generally use only a single sensor, fixed task. However for the intelligent system and autonomous system, people found that a single sensor cannot satisfy the need of target recognition, and operating environment, especially in the uncertain environment [11]. In this paper, a low power and minimally intrusive multi sensor network has been developed for health monitoring of elderly people. To save the power consumption of the unit, inactivity periods have been estimated using an algorithm during which the inactive sensor nodes are not polled by the central controller [13]. The commercially available sensor interface allows limited 4 to 5 sensors at input and only 2 or 3 types of outputs. Whereas in this new interface design there is flexibility of adding more sensors. The interface is divided into two parts a base unit and a sensor specific plug-in module. The base unit allows only one module to be plugged in. Each module consists of a signal conditioner for a specific sensor and the user has to adjust the DIP switches present on the module to indicate the type of sensor and range of measurement. The Universal Transducer Interface chips are available in the market and are costly and include high performance front-end circuits for resistive and capacitive sensors only [14]. This paper discusses ongoing research being carried out on an autonomic Smart sensor interface device is essential for sensor data collection of industrial wireless sensor networks (WSN) in IoT environments**.** The standard of IEEE1451.4 intelligent sensor interface specification is adopted for this design. The device is combined with the newest FPGA programmable technology and the standard of IEEE1451.4 intelligent sensor with specific specification [15].

III. CONCEPT OF UNIVERSAL INTELLIGENT SENSOR INTERFACE

The Universal intelligent Sensor Interface **(**UISI) can convert any generic transducer into a plug and play intelligent sensor (Figure 1). The configurable front-end of UISI provide the platform to achieve the goal of multi sensor interface. The UISI consists of two sockets; socket 1 is dedicated

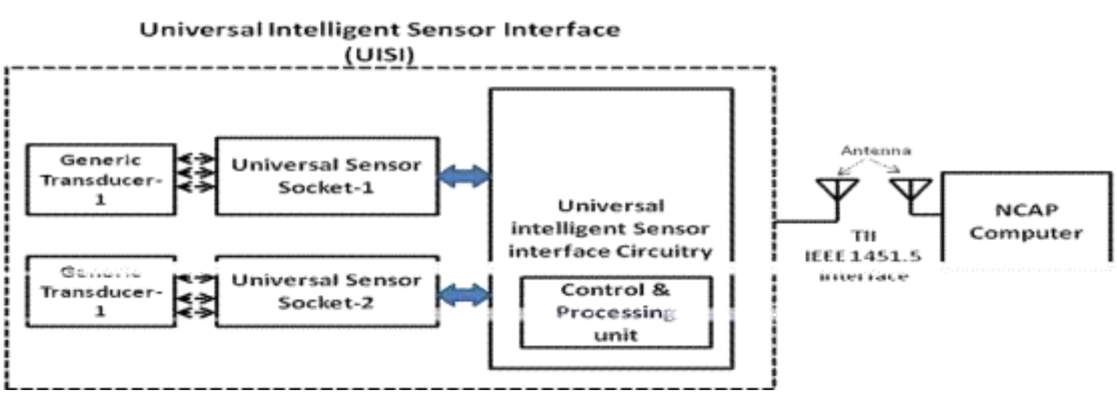


Figure 1 Basic UISI architecture

for analog sensors such as conditioned, unconditioned, resistive, capacitive, voltage and current output sensors, where as socket 2 is dedicated for digital sensors like RS232, SPI and I2C interface. The core of the UISI is a reconfigurable conditioning module, composed of OPAMP, DAC and ADC that can be connected to each other via the firmware in different ways, providing the required complete front end for different sensor including single/differential amplification, analog to digital conversion, powering and filtering. The conditioning module is directly configured by the processor which also manages the other operations of the device. The processor configure the conditioning module based on the configuration data stored in the memory, this is stored in the form of Transducer Electronics Datasheet (TEDS) which follow IEEE 1451 standard. The TEDS contain an electronic description of the sensor connected. A standard 8 bit processor is suitable for the application, due to relatively low computational performance required by the system. When the system is designed for the multi tasking application then the 16 or 32 bit processor is highly preferred. UISI is connected with NCAP by IEEE 1451.5compatable wireless module, The UISI can be configured or sensed data can be received to NCAP in a flexible manner.

IV.UISI DESIGN STRATEGY

The specific requirement of UISI devices in terms of flexibility, adaptability and functionalities can be achieved by using different technological solution, depending on the expected performance and cost. There is various technique of system design. First one is analog/digital mixed ASIC with configuration capability. This design has some limitations such as it is not upgradable, difficulties for rapid time to market design and the need of complex and expensive tool. The other solution is the use of the commercial available multi functional chip, which is compact, easy to configure and upgrade and its cost is lower compared to previous technology. The other technique is the electronic board including a microcontroller, operational amplifier, programmable gain amplifier (PGA), DAC, ADC and analog switches. Although the above system when used as the standalone system does not have sufficient advantage but when the above system is incorporated in other multi tasking system it give a desired result at lower cost. If it is used in multi tasking system then same processor can be used for both UISI and the main system. Hence the use of same processor reduces total system size and power consumption. Table 1 shows different sensors used to measure environmental parameters: Temperature, humidity, barometric pressure, light and different gas concentration. It also shows the different sensors front end, power supply requirement and nature of outputs. To interface this sensor to a common platform, UISI should have following versatility, first UISI need to provide a flexible power supply range from1.5V to 5 V as per the sensor interfaced, majority of sensors need supply current less then 25 mA which can be provided by a DAC. Although the semiconductor gas sensors require high drive current 500mA approximately and it can not be provided by a DAC, therefore a high current supply is required. There are some specific sensors which need power in periodically switching manner; therefore UISI should also have relay switch based power supply to address the above problem. Heterogeneous sensors like solid electrolyte, catalytic, ton oxide, electro chemical, galvanic cell, Infrared, capacitive, resistive and digital sensors need to interface to the universal socket, the sensors not only different by their nature of outputs they also differ by their output impedances, output levels, differential and non differential nature. Therefore the configurable front end of UISI should be designed by keeping this parameter in mind. A PoSC or a commercial available universal transducer interface chip can not provide application specific flexibility. Therefore hybrid approach is always preferable for such kind of scenario. Although

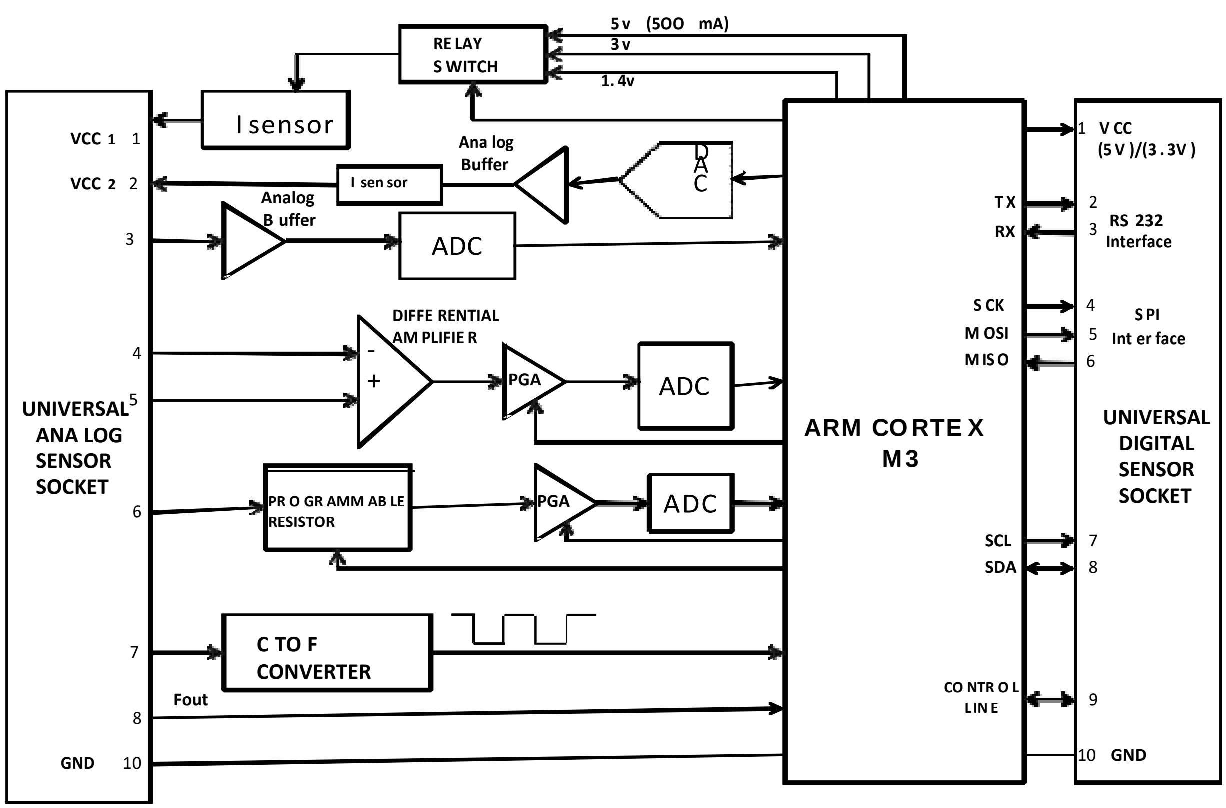


Figure.2: Internal UISI architecture

marginally it will increase the overall development cost and size. Two 10 pin socket of UISI can interface eight different types of sensor topology. Universal socket one provides duel power supply available on pin one and two. Pin two provides flexible power supply voltage range from 1.5V to 5V with maximum source current 25mA. There are three different voltages available in pin two1.4V, 3V and 5V with maximum current of 500mA.

V. DESIGN AND DEVELOPMENT OF UISI

The core of UISI is consists of two sections first a reconfigurable module to interface and conditioning different types of sensors and a 32 bit ARM cortex M3 based microcontroller platform. 32 bit microcontroller operated in 84 MHz is selected due to multi task requirement by the entire system in which UISI is a sub unit. In addition the microcontroller consists of various on chip peripherals like 4 USARTs 9-Channel 32-bit Timer/Counter (TC) for capture, compare and PWM mode, 32-bit Real Time Timer (RTT) One 2-channel 12-bit 1 Msps DAC, 512 Kb of flash memory and SRAM: 96 KB (two banks: 64KB and 32KB) which are used for subpart of UISI. The54 I/O lines as another major advantage of the controller. Figure 2 shows the internal architecture of UISI. The major components of UISI are two 10 pin socket, ADC, DAC, Programmable gain amplifier (PGA), Differential amplifier, switching circuit, programmable resistor, C to F converter etc. The hardware is software configurable. The CPU block directly configure the conditioning module and manages other function of UISI. Analog buffer is used to avoid any loading effect to the internal circuit it also protects from short circuit. The 14 channels 10 bits internal ADC of microcontroller is utilized to convert analog sensor output to digital form and to forward for further processing. Internal 6 bit DAC is used to power sensor which provide 0-5V variable power with maximum current of 30mA, the different supply voltage can be set automatically by extracting TEDS information for particular sensor from non volatile memory. The o/p range of sensor differs from each other, therefore to bring the sensor o/p to a desired level programmable gain amplifier (PGA) is used, the gain is set automatically by UISI by extracting gain factor for the sensor from TEDS data base. Sensors DAC can provide maximum 30mA current which is not sufficient to drive some specific sensor like gas sensors whose heter current requirement is typically 150-200 mA, therefore to power up such sensors special relay circuit is implemented on UISI provide 500mA peak current with three different voltage flexibility 1.4V, 3V and 5V. The appropriate supply voltage can be selected by the firmware

which triggers the relay circuit. The programmable resistor is used to interface the resistive sensor directly with UISI, the programmable resistor acts as second resistor of voltage divider network and resistive sensor acts as first resistor, due to different resistance o/p offers by the sensor programmable resistor is configured for optimum sensitivity and linearity. To interface capacitive sensor capacitive to frequency (C-F) converter is used. The differential amplifier also incorporated in the UISI to interface differential o/p sensors and then ADC is used to convert to digital form. The current sensor is deployed for each of the power output terminal of UISI to detect any loading effect and short circuit happens in the socket, if such scenario arises the system will be power off after
giving a small on board alarm and to the NCAP. These features enhance smartness of the system. The sensor can be connected to any of the two sockets directly with 10 pin socket depending on type and nature of out. On initial powering of UISI all input and output lines are placed to high impedance state and configure only after reception of command from NCAP, the configuration is done by the internal firmware.

The digital sensors can be interfaced directly to the UISI socket two which support three different topologies; RS232, SPI and I2C. The core microcontroller gives the facility to interface these sensors without any external hardware. To power digital sensor two voltages 5V and 3.3V are available and selectable by the firmware. Table 2 shows the function of different pin of UISI sockets. The custom TEDS stored in the flash memory configures and provides suitable frontend required to interface selected transducer in proper way. The TEDS contains parameter required to configure the hardware. Eight different topology sensors can be interfaced in the UISI. Each sensor requires specific architecture and it is implemented at the firmware level by configuring the reconfigurable module.

1. Conditioned Sensor;
2. Unconditioned Sensor;
3. Current Sensor;
4. Resistive sensor;
5. Capacitive sensor;
6. Digital sensor (I2C,SPI, RS232)

Socket 1 (Analog Sensors)				Socket 2 (Digital Sensor)			
Pin no	Function	Pin no	Function	Pin no	Function	Pin no	Function
1	1.4/3/5v Supply 500 mA (O/P)	6	Resistive sensor I/P	1	VCC 5V/3.3V	6	MISO (SPI)
2	0-5v, 30mA (O/P)	7	Capacitive sensor I/P	2	RX for sensor (RS232)	7	SCL (I2C)
3	I/P for conditioned sensor	8	Frequency sensor I/P	3	TX for sensor (RS232)	8	SDA (I2C)
4	1st I/P for differential sensor	9	N/C	4	SCK (SPI)	9	Control line
5	2nd I/P for differential sensor	10	Ground	5	MOSI (SPI)	10	Ground

Table 2: UISI Socket description

VI. CONDITIONED SENSOR INTERFACE WITH UISI

The output of the conditioned sensor is usually in the range of 0-5v. The output signal from sensor does not require amplification as it has very low output impedance. The output of sensor is referred to ground as it is not a differential output. The basic interface circuit required for this type of sensor is DAC, ADC and analog buffer. The power to the sensor is provided from microcontroller via the 6 bit DAC, but DAC provides current in mA range. In case if the sensor requires high drive current DAC output can not be used as power source. To power sensors like shown in figure 3 require typical current of 150mA. A DAC can not provide the current. Therefore two provisions have been considered first low current variable DAC output obtainable at pin no 2 of universal socket 1 and second is three stage 5v/3v and 1.4v with 500mA source current obtainable at pin 1 of universal socket 1. Analog buffer is used to avoid any loading effect and to protect the central embedded system from short circuit. The gain of the analog buffer is usually set at 1.

VII. UNCONDITIONED SENSOR INTERFACE WITH UISI

The analog signal from buffer is digitized using 12 bit ADC and it is fed to microcontroller for further processing. The embedded firmware configure the frontend and switched the appropriate power using relay switch circuit according the inbuilt or run time TEDS configuration. Ideally all the outputs of socket are kept into high impedance state. This configuration can be used to interface any conditioned sensor with duel variable power supply with drive current up to 500mA.

VIII. RESISTIVE SENSOR INTERFACE

For interfacing resistive sensor, a half bridge circuit can be used. The output of the half bridge circuit is given by the equation $\mathbf{Vout = (R_L / R_S + R_L) \times VCC}$. Where R_L is load resistance and R_S is sensor resistance. The sensitivity of half bridge circuit is given by $\mathbf{S = dv_{out}/dx}$ Where x is the unknown input parameter. To achieve maximum sensitivity $R_L = R_S$. There is various type of resistive sensor commercially available, they are thermistor, LDR, etc. the typical resistance of LDR are in the range of 100 KΩ and the resistance of thermistor are in the range of few hundred ohms at room temperature. So in order to get maximum sensitivity R_L must be varied in accordance to R_S. Therefore a programmable resistor is used to select the optimum R_L which provides maximum sensitivity. Linearity and sensitivity are reciprocal of each other. Hence depending on the priority of linearity and sensitivity R_L will be optimized configuring AD5246 programmable resistor by the firmware. AD5246 gives flexibility to choose any of the resistance of 5KΩ, 10KΩ 50KΩ and 100KΩ. The bridge circuit is powered from VCC (pin2) and the unknown resistance is connected between pin 6 and ground of USSI1 shows in figure 5.

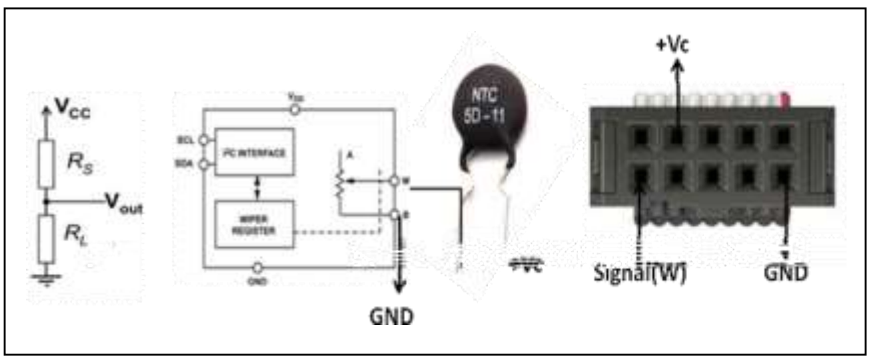


Figure 5: interfacing of resistive sensor

The scenario becomes more complicated to interface sensors like MQ7, which require heater voltage in periodically switching manner, the on time is 60 sec and off time is 90 sec, not only that on and off time require voltages are 5V and 1.4V respectively, supply current requirement is 150mA. The sensor need duel power, a constant 5V require for sensor circuit voltage obtainable at pin no 2 of UISI1, and high current duel level power supply (1.4 and 5V) available at pin one of UISI1. The two level voltage switching is done by relay switching circuit. Figure 6 shows the MQ7 signals and interfacing guidelines to UISI1.

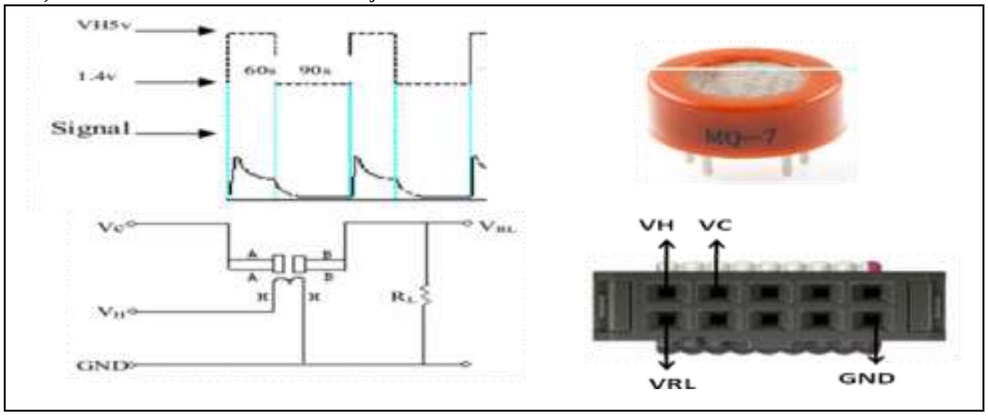


Figure 6: interfacing of MQ7 with UISI

IX. DIGITAL SENSOR INTERFACE

There is separate 10 pin connector used to interface digital sensors. There are mainly three types of front ends available for digital sensors namely I2C, SPI and RS232. Universal socket 2 provides solution for these digital frontends. The socket is powered by 3.3V or 5V which is software selectable and delivers source current up to 100mA. Figure 7 shows how different digital sensors having different front ends can be interfaced with the socket. Data rate is software configurable and having default baud rate of 9600. Pin 9 is reserved for control signal which is bi directional in nature.

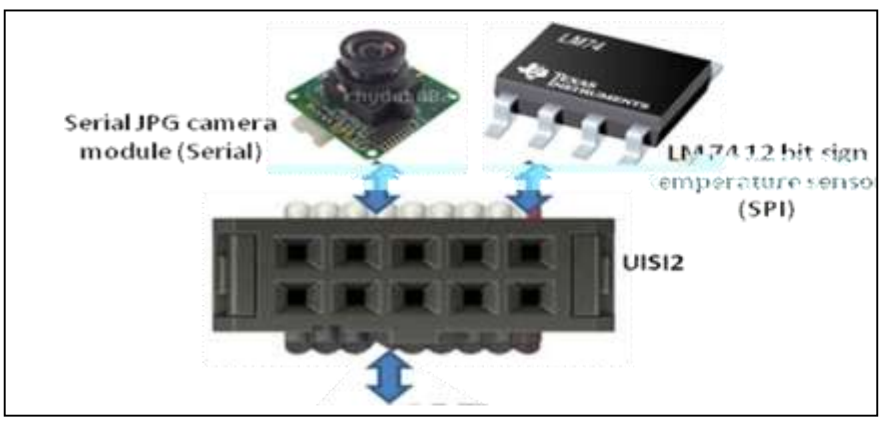


Figure 7: interfacing of digital sensor with UISI

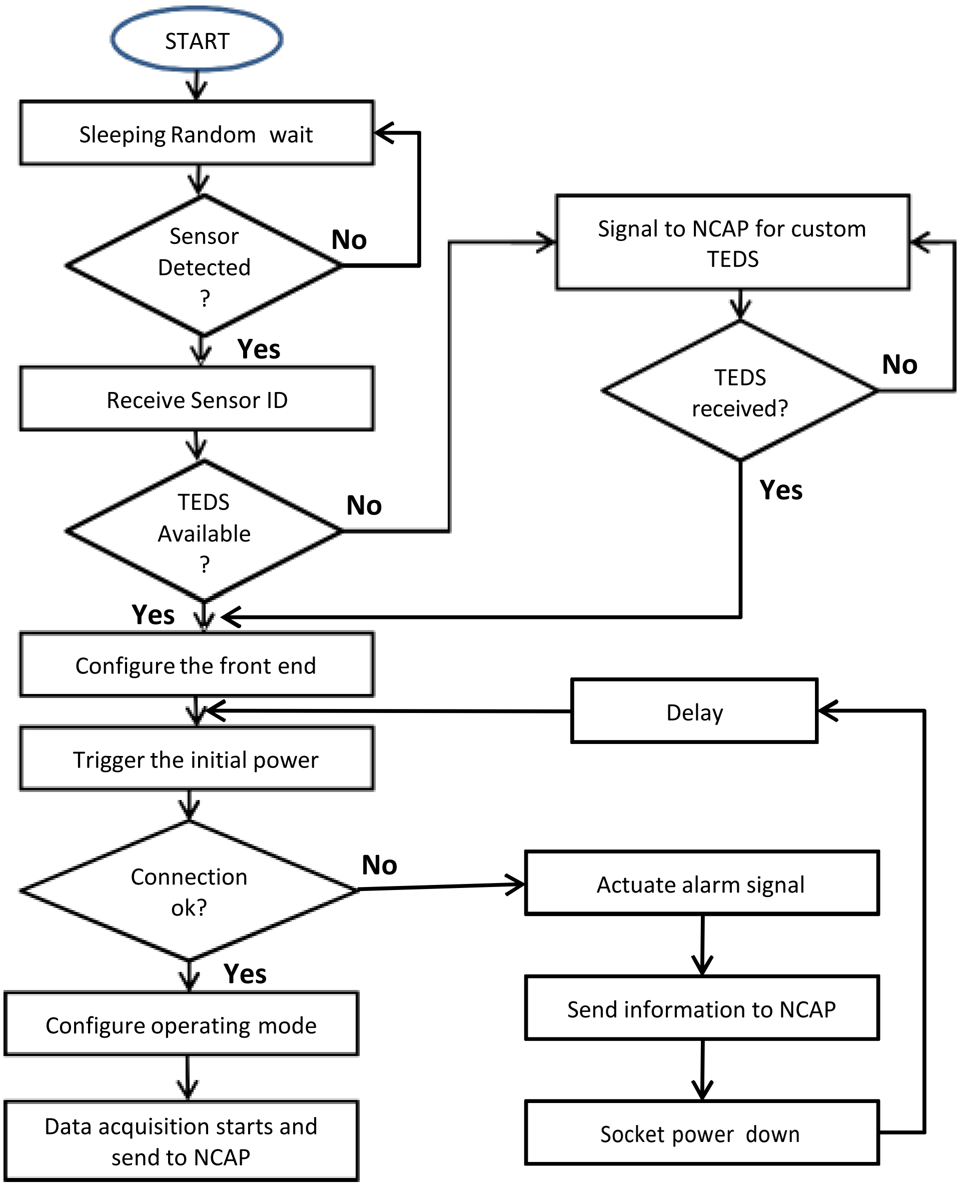


Figure: 8 Flow diagrams for UISI

The figure 8 shows the flow diagram of the process of interfacing the sensor to the UISI. Initially the front end of the UISI is in sleep mode until any sensor is connected to it. The UISI has current sensor incorporated in it, so if any sensor is connected to it then it will detect easily by observing the change in current due to the sensor. When UISI is turned ON, a procedure for sensor ID assignment and TEDS transmission required for plug and play connectivity is activated. The UISI switch from sleep mode to active mode if any sensor is detected else it will again go back to sleep mode. After the sensor is connected sensor's ID is acquired and stored in the volatile memory. This ID with be compared with the ID sent by the NCAP for extracting TEDS information. If the TEDS information is not available then the remote device will send the query signal demanding the custom TEDS for the connected sensor to NCAP wirelessly using 2.4GHz link. If TEDS information is received from NCAP the device will proceed further else it will again send the query signal. On receiving the TEDS information the device will configure its front end according to the received information. Once initial configuration is done then the sensor are given supply. After the supply if there is any fault then device will actuate a alarm signal which will be transmitted to the NCAP wirelessly. On receiving this information the power to the socket will be switched off. If there is no problem when power is switched ON then the particular operating mode is configured. Once the configuration is completed the data acquisition from the sensor will be started and the sensed data is sent to NCAP wirelessly.

X. PROTOTYPE VALIDATION AND EXPERIMENTAL RESULTS

The hardware prototype is developed using cortex M3 based microcontroller based customized Embedded platform. The main novelty of the system is that user can remotely interact with the UISI once the sensor is attached. Figure 9 shows the GUI screen available at NCAP when a user wants to interface a new sensor. This GUI provide flexibility to carry out various operation Including TEDS information extraction and selection menu for different types of sensors, by providing proper input information, which enhances user friendly characteristics of the system.

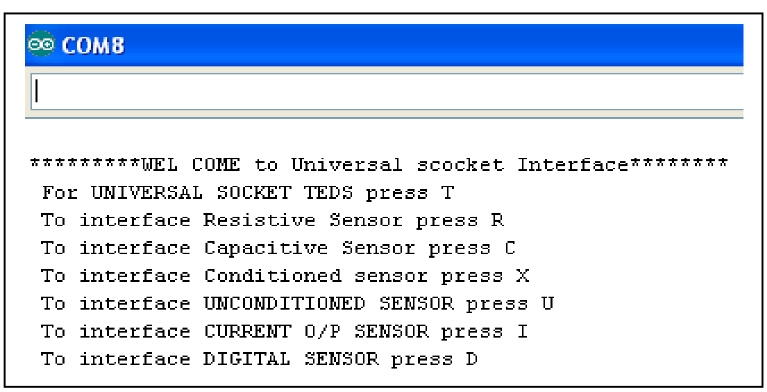


Figure 9: screen shot for types of sensor interfacing

Figure 10: Sensor mounted on UISI with LCD display

The user can also provide the customers information by interacting wirelessly from NCAP. The user can chose five different analog sensor types and three different types digital sensor. Figure 10 shows the LDR is mutated on universal socket one and the LED confirm the connection correctness and same also displayed in the LCD display. All these information also passed to NCAP available in serial monitor.

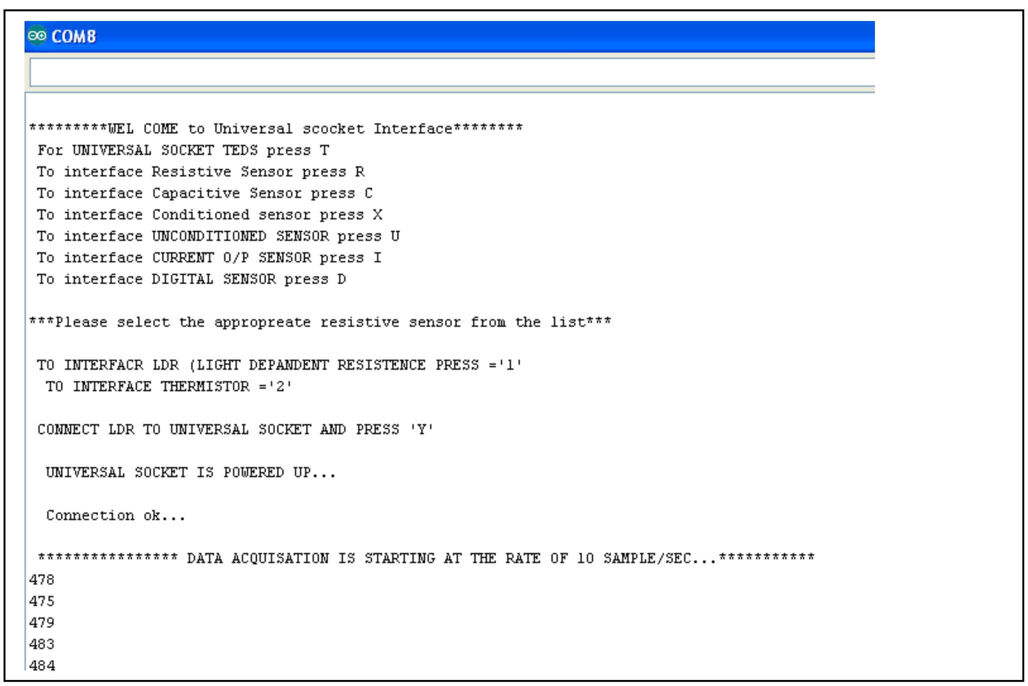


Figure 11: Data acquisition from UISI

Figure 11 shows sensor data acquisition procedure from UISI to NCAP. When a user wants to connect a new sensor via UISI, the first menu appear in the screen which provides user, the options to select the type of sensor he/ she wants to connect. Here the selection was made as “R” which indicates the sensor to be connected is resistive type. Once this selection is done a new option appear, which helps to user to select from two option i.e. LDR and thermistor. After selection of particular type of resistive sensor, it displays information for user to connect the sensor and press “Y”. Then the socket is powered ON, if the connection is found proper then the data acquisition will start at the rate of 10 samples/sec. the displayed data is the digitized output of LDR. If in case of improper connection the socket will not be powered up and error message will be displayed. This feature avoids the damage of sensor due to improper connection.

Figure.12: Gas sensor interfacing with UISI

Figure 13: LM 35 sensor interfacing with UISI

Figure 12 and 13 also shows the interfacing TGS 2600 gas sensor and LM 35 temperature sensor interfacing with UISI. The system provides flexibility to select the data rate and different operating mode. The internal relay switching circuit board with controller used to trigger the different gas sensors is shown in figure 14. There are basically nine relays for switching the various type of sensor connected via UISI. The particular relay will be triggered based on the information provide by user via GUI. The information provided by the user is processed by the controller, which in turn control the switching of the relay to power on the sensor connected in the socket. The prototype is tested with different sensor and typical room environment condition.

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Figure 15 shows the output obtained during test phase of TGS 880 gas sensor. Data was sampled at 10 samples per second; iso butane was used as sampled gas a unconditioned TGS 880 vaporized gas sensor was directly connected in UISI.

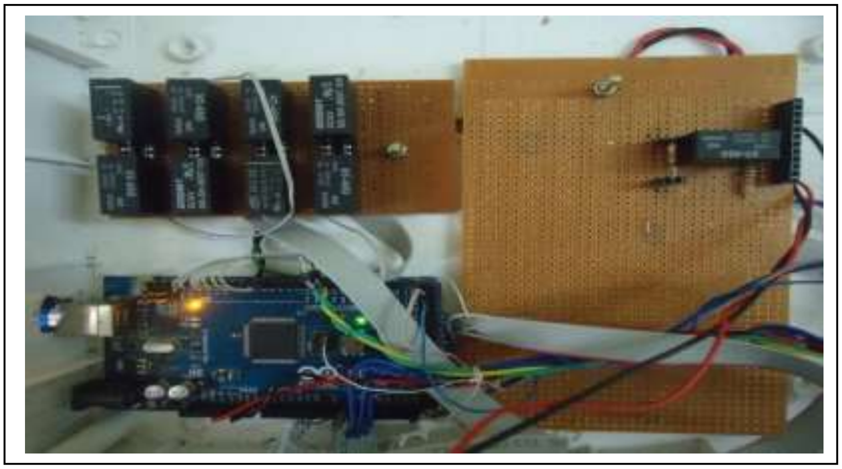

Figure 14: internal relay with controller for sensor

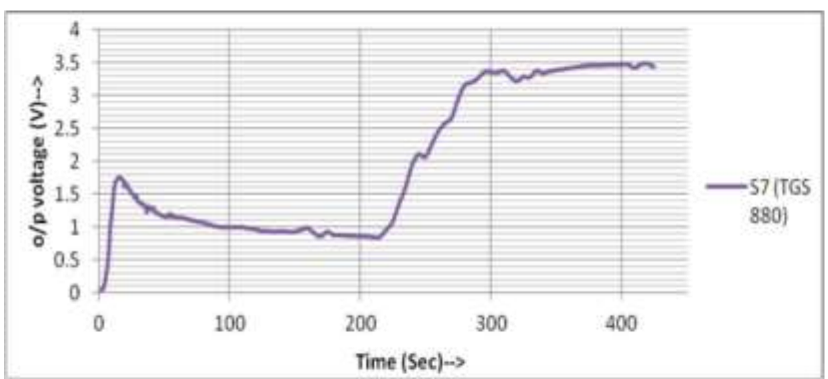

Figure 15: output graph for TGS

XI. CONCLUSION

This paper deals with the design and development of UISI consists of two sockets. Some of the specialty of this system is as follows. The main novelty of the system is that it is very user friendly, a user without having depth knowledge about the sensor can easily deal with the system by utilizing the TEDS information. All the required processing and operation are handled by the single processor which makes the system compact and easy to handle. The UISI is designed specially to interface sensor frequently used for environmental monitoring application, without any signal conditioning part involved in sensor end. Two universal sockets can work parallel in the system. The sensed data can be obtained wirelessly from up to 1Km distance, which makes the system flexible. The firmware also embedded with power management and error detection protocol can detect some of the errors occurs in the user side which may leads to damage of sensor socket, but due embedded protocol system can detect the errors in preliminary stage and take appropriate action to avoid any damage or short circuit which also protect the sensor. This is operated by 84 MHz clock leads to faster operation. IEEE 1451 compatible smart sensor standard makes it globally acceptable format. The entire system is designed with basic available cost effective components; however there is a slight compromise in system compactness due to this strategy.

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