

REVIEW: COMPARATIVE ANALYSIS OF ORDINARY TRANSDUCER AND SMART TRANSDUCER

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Abstract: We can transform energy in one form to another with the help of the transducer. Currently in the era of smart technology, we will require smart transducer in various applications. It is a mixture of analog or digital sensor and actuator element, a processing unit and a communication interface. In this paper, ordinary transducer and smart transducer will be compared on the basis of sensing element, feedback and standard. The best achievable goal of this paper is to display the best things of smart transducer and its future use in several applications.

IndexTerms - Smart transducer, transducer, energy conversion, future of transducer.

I. INTRODUCTION

The transducer is a device which converts energy from one form to another form. In other word, the transducer converts the physical quantity to electrical quantity. This device deals with different types of energies that is electrical, chemical, mechanical, acoustic, etc. So without transducer, it is difficult to measure the continuous physical quantity which can be light intensity, speed, temperature, etc. [1]

Now in the era of smart technology, various smart transducers are developed. Smart transducer is a mixture of analog or digital sensor and actuator element, a processing unit and a communication interface. It consists of transduction element, signal conditioning electronics and controller/ processor that support some intelligently in a single package. So smart transducer has ability to make some decisions.

The transducer is classified in five ways:

- On the basis of transduction form used e.g. resistive, capacitive, inductive
- As primary and secondary transducer e.g. LVDT
- As passive and active transducer e.g. thermocouple, piezoelectric crystal
- As analog and digital transducer e.g. thermistor, strain gauge
- As transducer and inverse transducer e.g. analog ammeter, voltmeter [6]

The characteristic of the transducer is determined by observing the output in response to a variety of inputs. The characteristics of transducers are: accuracy, precision, sensitivity, resolution, distortion, noise, etc. [4]

There are several transducers available in the market. Factor affecting transducer selection are: sensitivity, operating range, accuracy, errors, stability, environmental capabilities, insensitive to unwanted signal, etc.

The applications of transducer are:

- It is used in antenna for converting electromagnetic wave into an electrical signal.
- It is used in speaker and microphone for converting electrical signal into acoustic sound and sound into an electrical signal.
- It is used for measuring the load of engines.
- It also uses ultrasound machine.
- It is used to measure the pressure of gas and liquid by converting it into an electrical signal.
- It measures the temperature of the device and convert it into an electrical signal.
- It is also used in detection of movement.

II. ORDINARY TRANSDUCER

As said earlier transducer is a device which converts energy from one form to another form. The transducer has two parts:

- Sensing element:
Sensing element which detects and gets information from the real world. Different types of sensing elements are used for measuring different quantity such as LDR, photodiode, thermocouple, thermistor, strain gauge, load cell, potentiometer, LVDT, microphone, piezoelectric crystal, etc.
- Transduction element or actuator:
Transduction element which generates a signal or data for further used. Different types of actuator elements are used for measuring different quantity such as LED, lamp, heater, fan, AC and DC motors, loud speaker, etc. [2] [9]

III. SMART TRANSDUCER

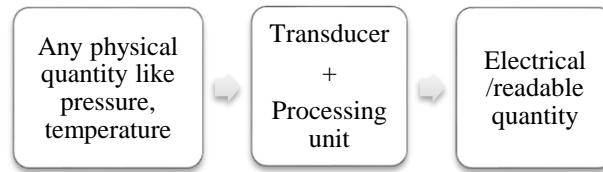


Figure-1 basic architecture of smart transducer [author 1]

As said earlier Smart transducer is a mixture of analog or digital sensor and actuator element, a processing unit and a communication interface. The essential part of the smart transducer is the microprocessor. The function of the microprocessor such as digital processing, interface, function and calculation according to collected data.

The sensor and transducer are often used as synonyms. The smart word has been added as prefix to many things means the things possess some form of intelligence. The smart word was adopted about mid of 1980. The general characteristic of smart transducers is: accuracy, precision, range, span, signal to noise ratio, linearity, hysteresis, fidelity, speed of response, etc.

There are different types of smart transducer available:

- Temperature transducer
- Smoke and gas transducer
- IR transducer
- Ultrasonic transducer
- Water quality transducer, etc.

Now a day, the use of smart transducer is increasing, so a smart transducer interface standard is needed. The IEEE has introduced IEEE 1451 which is set of smart transducer interface standard. A key concept of IEEE 1451 standard is Transducer Electronic Data Sheet (TEDS) which contains information about sensors such as sensor type, serial number, calibration and standardized data format for the TEDS. [8] [10]

Smart transducer provides high performance and high reliability. It is easy to use, design and maintain. It provides a scalable and flexible system.

The applications of smart transducer:

- Industrial
- Automotive
- Fingerprint recognition
- Pattern recognition
- Telecommunication
- Smart toys and dust
- Biomedical application
- MEMS and process control
- Defence application and many more.

IV. COMPARISION

For a better decision making of which transducer should be used, the comparisons of ordinary transducer and smart transducer on various parameters must be done. Transducer and smart transducer will be compared on the basis of sensing elements, feedback, and standard.

The detailed table of comparison is given by below table1.

Table 1. comparison between ordinary transducer and smart transducer

Basis for comparison	Ordinary transducer	Smart transducer
Definition	It is a device which transforms energies from one form to another form.	It is a device which senses the physical quantity from the environment and convert it into electrical signal or readable quantity.
Function	A transducer is the element within that assembly which accomplishes only the detection of the event.	A smart transducer is the complete assembly required to detect and communicate a particular event.
Examples	LVDT, thermistor, strain gauge, etc.	IR, ultrasonic, temperature, etc.
Sensing element	Sensor and Actuator	Analog or digital Sensor and actuator, processing unit and communication interface
Feedback	The transducer can convert between any form of energy they can be used to provide feedback to the system.	Smart transducer measures a quantity and cannot by itself, give feedback to the system
Decision ability	Ordinary transducer has no ability to take decisions	Smart transducer has the ability to take decisions
IEEE standard	No	IEEE standard 1451 is available.

V. FUTURE SCOPE

In present day, smart transducers solve many problems and at the same time it provides comfort to many people. Smart transducers play an important role with the advent of the internet of things. Thus, the future is bright with innovative and creative, smart transducer system.

1. Smart manufacturing

In a manufacturing environment, smart transducer is used to monitor and improve the quality of products. Smart transducer detects the quantity such as temperature, pressure, flow control, vibration, etc. Smart transducer analysis the data. If critical data are achieved, preventive action is carried out.

2. Disease detection

Biosensor concept is carried out for disease detection. It is a combination of principle of both biology and electronics. It is used in cancer diagnosis, Alzheimer diseases, Diabetes mellitus, Tuberculosis, etc.

3. Agriculture and food industries.

In effective agriculture, smart transducer is used to monitor the weather, insect or disease in plant, soil, crop, irrigation, etc. In food industries, the primary concern is to study and analysis the temperature of refrigeration room, container, trucks, etc.

4. Damage detection in concrete

Smart transducer is used to detect the damage in concrete structures. E.g. Pile damage like cracks, fractures, mud intrusion are the main causes of construction failure. This causes severe loss of economy and lives.

5. Smart power grids

A smart grid is an electrical power distribution system. Smart transducer monitors the remote equipment like transformer, power line on the energy smart grid. It is also used to calculate the line carrying capacity and power loss on the power line.

6. Smart traffic management

Smart transducer monitors the real time traffic. It collects and analysis the data and based on that traffic is controlled accordingly.

Smart transducers play an important role in our everyday life and in IOT. In the development of smart transducer, it is used in several IOT projects. IOT collects the data from the sensor devices like homes, our body, building, farms, industry etc. It sends data at high speeds across the networks like cloud computing, private data center, home network etc. Then analyses data and creates a useful information from the data and taking an action based on data available. The transmission of data is being done automatically. [5]

There are several IOT projects available with the help of two most popular boards:

- Arduino UNO
- Raspberry Pi

Arduino UNO is a microcontroller based board which is easy to use and a good starting point. It has analog and digital pins which are perfect to use with the analog and digital sensors.

Raspberry pi is the single board computer which is introduced by the raspberry pi foundation. It is available in different version. It has a USB port, HDMI port, GPIO pins, etc. [7]

VI. CONCLUSION

The measurement of any physical quantity is easy and convenient with the help of smart transducer. It gives more accurate results and helps to reduce the cost of projects and there is limitless future scope for its applications.

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