INTRODUCTION

Sensor is a device that detects or senses the value or changes of value of the variable being measured. The term sensor some times is used instead of the term detector, primary element or transducer.

The fusion of information from sensors with different physical characteristics, such as light, sound, etc enhances the understanding of our surroundings and provide the basis for planning, decision making, and control of autonomous and intelligent machines.

SENSORS EVOLUTION

A sensor is a device that responds to some external stimuli and then provides some useful output. With the concept of input and output, one can begin to understand how sensors play a critical role in both closed and open loops.

One problem is that sensors have not been specified. In other words they tend to respond variety of stimuli applied on it without being able to differentiate one from another. Neverthless, sensors and sensor technology are necessary ingredients in any control type application. Without the feedback from the environment that sensors provide, the system has no data or reference points, and thus no way of understanding what is right or wrong g with its various elements.

Sensors are so important in automated manufacturing particularly in robotics. Automated manufacturing is essentially the procedure of remo0ving human element as possible from the manufacturing process. Sensors in the condition measurement category sense various types of inputs, condition, or properties to help monitor and predict the performance of a machine or system.

SENSOR AND SENSOR TECHNOLOGY IN THE PAST

The earliest example of sensors are not inanimate devices but living organisms. A more recent example of living organisms used in the early days of coal mining in the United States and Europe.

Robots must have the ability to sense and discriminate between objects. They must then be able to pick up these objects, position them properly and work with them without damaging or destroying them.

Intelligent system equipped with multiple sensors can interact with and operate in an unstructured environment without complete control of a human operator. Due to the fact that the system is operating in a totally unknown environment, a system may lack of sufficient knowledge concerning the state of the outside world. Storing large amounts of data may not be fesible. Considering the dynamically change world and unforeseen events, it is usually difficult to know the state of the world. Sensors can allow a system to learn the state of the world as needed and to cautiously update its own model of the world.

SENSORS PRINCIPLES

A sensor is defined as a measurement device which can detect characteristics of an object through some form of interaction with them.

Sensors can be classified into two categories:

Contact and noncontact. A contact sensor measure the response of a target to some form of physical contact .this group of sensors responds to touch, force ,torque,pressure,temperature or electrical quantities.

A noncontact type sensor measures the response brought by some form of electromagnetic radiation. This group of sensors responds to light, x-ray, acoustic, electric or magnetic radiation.

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MULTISENSOR FUSION AND INTEGRATION

Multisensor integration is the synergistic use of the information provided by multiple sensory devices to assist in the accomplishment of a task by a system.

Multisensor fusion refers to any stage in the integration process where there is an actual combination of different sources of sensory information into one representational format.

MULTISENSOR INTEGRATION

The diagram represents multisensor integration as being a composite of basic functions. A group of n sensors provide input to the integration process. In order for the data from each sensor to be used for integration, it must first be effectively modelled. A sensor model represents the uncertainty and error in the data from each sensor and provides a measure of its quality that can be 7used by the subsequent integration functions.

After the data from each sensor has been modelled, it can be integrated into the operation of the system in accord with three different types of sensory processing: fusion, seperate operation, and guiding or cueing.

Sensor registration refers to any of the means used to make data from each sensor commensurate in both its spatial and temporal dimensions. If the data provided by a sensor is significantly different from that provided by any other sensors in the system, its

influence on the operation of the sensors might be indirect. The separate operation of such a sensor will influence the other sensors indirectly through the effects he sensor has on the system controller and the world model. A guiding or cueing type sensory processing refers to the situation where the data from one sensor is used to guide or cue the operation of other sensors.

The results of sensory processing functions serve as inputs to the world model .a world model is used to store information concerning any possible state of the environment that the system is expected to be operating in. A world model can include both a priori information and recently acquired sensory information. High level reasoning processes can use the world model to make inferences that can be used to detect subsequent processing of the sensory information and the operation of the system controller.

Sensor selection refers to any means used to select the most appropriate configuration of sensors among the sensors available to the system.

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MULTISENSOR FUSION

The fusion of data or information from multiple sensors or a single sensor over time can takes place at different levels of representation.

The different levels of multisensor fusion can be used to provide information to a system that can be used for a variety of purposes.eg signal level fusion can be used in real time application and can be considered as just an additional step in the overall processing of the signals, pixel level fusion can be used to improve the performance of many image processing tasks like segmentation ,and feature and symbol level fusion can be used to provide an object recognition system with additional features that can be used to increase its recognition capabilities.

APPLICATIONS OF MULTISENSOR FUSION AND INTEGRATION

In recent years, benefits of multisensor fusion have motivated research in a variety of application area as follows

1 Robotics

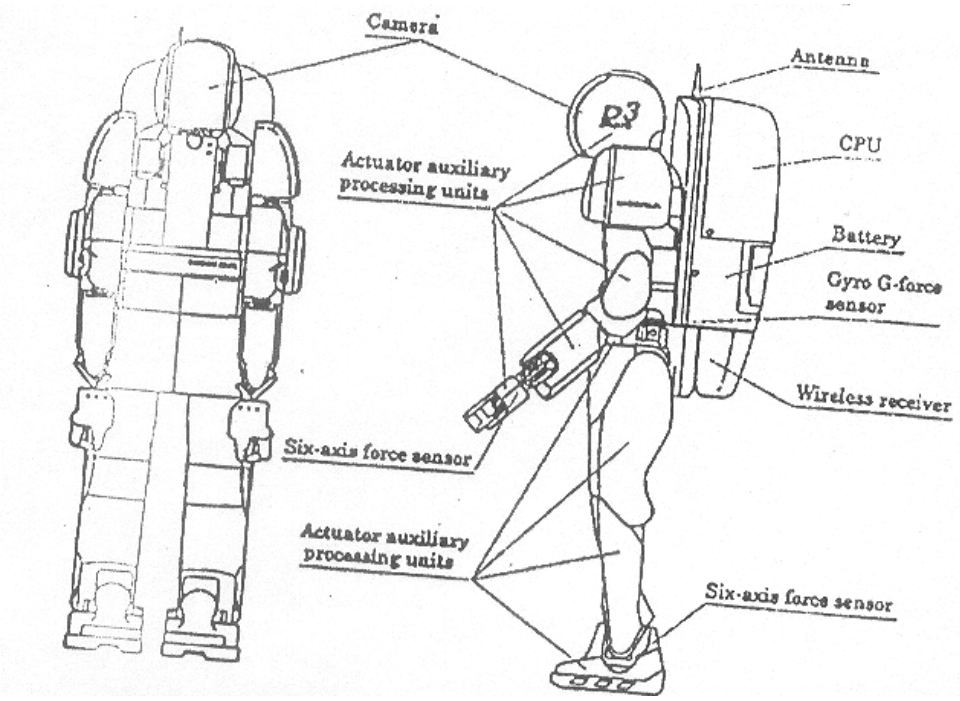
Robots with multisensor fusion and integration enhance their flexibility and productivity in industrial application such as material handling, part fabrication, inspection and assembly.

Mobile robot present one of the most important application areas for multisensor fusion and integration .When operating in an uncertain or unknown environment, integrating and tuning data from multiple sensors enable mobile robots to achieve quick perception for navigation and obstacle avoidance.

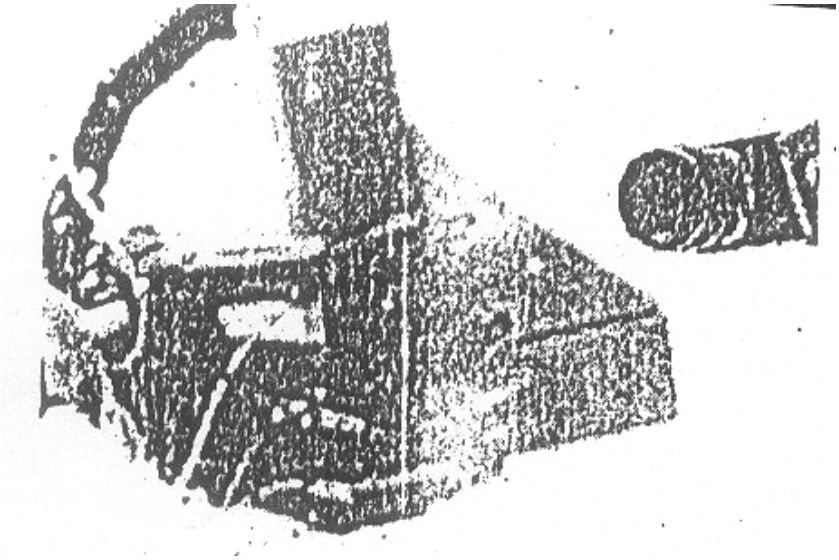
Marge mobile robot equipped with multiple sensors.perception, position location, obstacle avoidance vehicle control, path planning,

and learning are necessary functions for an autonomous mobile robot.

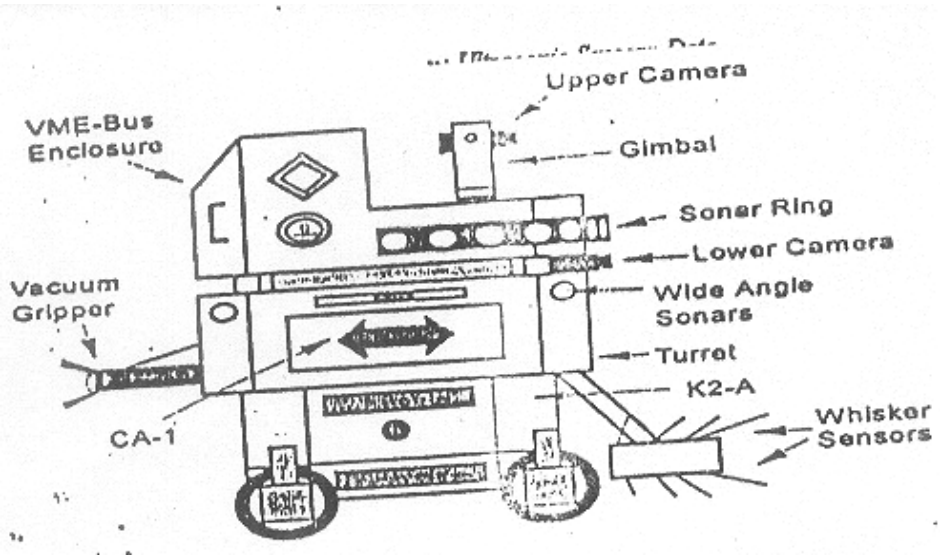
Honda humanoid robot is equipped with an inclination sensor that consists of three accelerometer and three angular rate sensors. each foot and wrist is equipped with a six axis force sensor and the robot head contains four video cameras.multisensor fusion and integration of vision ,tactile,thermal,range,laser radar, and forward looking infrared sensors play a very important role for robotic system.



Honda humanoid robot



Anthrobot five-fingered robotic hand holding an object in the field of-view of a fixed camera.



MARGE mobile robot with a variety of sensors

Military application

It is used in the area of intelligent analysis, situation assessment, force command and control, avionics, and electronic warfare. It is employed for tracking targets such as missiles, aircrafts and submarines.

Remote sensing

Application of remote sensing include monitoring climate, environment, water sources, soil and agriculture as well as discovering natural sources and fighting the important of illegal drugs. Fusing or integrating the data from passive multispectral sensors and active radar sensors is necessary for extracting useful information from satellite or airborne imaginary.

Biomedical application

Multisensor fusion technique to enhance automatic cardiac rhythm monitoring by integrating electrocardiogram and hemodynamic signals. Redundant and complementary information from the fusion process can improve the performance and

robustness for the detection of cardiac events including the ventricular activity and the atria activity.

Transportation system

Transportation system such as automatic train control system, intelligent vehicle and high way system, GSP based vehicle system, and navigation air craft landing tracking system utilize multisensor fusion technique to increase the reliability, safety, and efficiency.

FUTURE RESEARCH DIRECTIONS

The current state of the art in multisensor fusion is in continuous development. there are therefore, promising future research areas the encompass multilevel sensor fusion ,sensor fault detection, micro sensors and smart sensors, and adaptive multisensor fusion as follows.

Multilevel sensor fusion

Single level sensor fusion limits the capacity and robustness of a system, due to the weakness in uncertainity, missing observation, and incompleteness of a single sensor.therfore there is a clear need to integrate and fuse multisensor data for advanced system with high robustness and flexibility and the multilevel sensor fusion system is needed in advanced system.

There are different levels, low level fusion methods can fuse the multisensor data, and medium level fusion methods can fuse data and feature to obtain fused feature or decision. High level

fusion methods can fuse feature and decision to obtain the final decision.

Fault detection

Fault detection has become a critical aspect of advanced fusion system design. Failures normally produce a change in the system dynamics and pose a significant risk. There are many innovative methods have been accomplished.

Micro sensors and smart sensors

Successful application of a sensor depends on sensor performance, cost and reliability.

However, a large sensor may have excellent operating characteristics but its marketability is severely limited by its size. Reducing the size of a sensor often increases its applicability through the following.

1 lower weight and greater portability

2 lower manufacturing cost and fewer materials

3 wider range of application.

Clearly, fewer materials are needed to manufacture a small sensor but the cost of materials processing is often a more significant factor. The revolution and semiconductor technology have enabled us to produce small reliable processors in the form of integrated circuits. The microelectronic applications have led to a considerable demand for small sensors or micro sensors that can fully exploit the benefits of IC technology. Smart sensors can integrate main processing, hardware and software. According to the definition proposed by Breckenridge and Husson, a smart sensor must possess three features

The ability to

Perform logical computable functions

Communicate with one or more other devices and

Make a decision using logic or fuzzy sensor data

Adaptive multisensor fusion

In general, multisensor fusion requires exact information about the sensed environment.however, in the real world, precise information about the sensed environment is scare and the sensors are not always perfectly functional.therfore a robust algorithm in the presence of various forms of uncertainty is necessary.

Researchers have developed adaptive multisensor fusion algorithm to address uncertainties associated with imperfect sensors.

CONCLUSION

Sensors play an n important role in our everyday life because we have a need to gather information and process it for some tasks. Successful application of sensor depends on sensor performance, cost and reliability.

The paradigm of multisensor fusion and integration as well as fusion techniques and sensor technologies are used in micro sensor based application in robotics, defense, remotesensing, equipment monitoring, biomedical engineering and transportation systems. Some directions for future research in multisensor fusion and integration target micro sensors and adaptive fusion techniques. This may be of interest to researches and engineers attempting to study the rapidly evolving field of multisensor fusion and integration.

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ABSTRACT

Multisensor fusion and integration is a rapidly evolving research area. Multisensor fusion and integration refers to the combination of sensory data from multiple sensors to provide more accurate and reliable information.

The potential advantage of multisensor fusion and integration are redundancy, complementarity, timeliness and cost of the information.

Application of multisensor fusion and integration are also in the area of robotics, biomedical system, equipment monitoring, remote sensingand transportation system.

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