# STRATEGY FOR STREAM EVENT SEARCH TO ENHANCE SITUATION RECOGNITION IN RESTRICTED IOT ENVIRONMENTS

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**Article History: Received:** 12.12.2022 **Revised:** 29.01.2023 **Accepted:** 15.03.2023

**Abstract**

A method of identifying the core sensor among the sensors arranged in this fashion is suggested in this paper. This is due to the fact that, after the primary sensor has been identified, situational inference may be benefited from by observing the linking activities with other sensors that are dependent on the sensor. Commercialization models have been able to make decisions about which sensors should be the group's centre up to this point based on the knowledge and views of experts, but it is now required for the system to intelligently centre and choose standard sensors without human assistance. In this study, the event frequency is examined, and the reported data stream is chosen as the reference data stream in order to identify sensor data, which is the core of each sensor and the standard for sensor data streams for scenario detection.

**Keywords:** Internet of Things, Context Awareness, Data Stream, Event Search

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**DOI: 10.31838/ecb/2023.12.s3.144**

## 1. Introduction

In essence, the Internet of Things' intelligent systems make use of a variety of sensors. Depending on the situation, sensors help detect different occurrences. It is challenging to respond to such sensor data using a conventional manner because sensors transmit such detection results to hosts and because different types of sensors must be employed and continually report detection results over time. The Internet of Things environment uses a variety of sensors that provide situation-related sensing data to the host. At this point, a grouping phenomena may emerge whereby the sensing activities of the sensors are connected to one another based on various real-world circumstances. For instance, temperature, humidity, and carbon monoxide sensors will report the observed data as dramatically altered values in the case of a fire. A city sensor, a humidity sensor, and a fine dust sensor will all provide sensory information on the safety and development of the kids if fog is present. As the scenario is so varied, the sensors belonging to the sensor group may overlap and take part in several groups. The actual situation is accompanied by a variety of phenomena, and sensors that detect each phenomenon may be organised into one group. It should be remembered that no two sensors can operate at the same frequency all the time.

In light of this, this paper suggests a strategy for identifying the centre sensor among the sensors arranged in this fashion. This is due to the fact that, after the primary sensor has been identified, situational inference may be benefited from by observing the linking activities with other sensors that are dependent on the sensor. Commercialization models have been able to make decisions about which sensors should be the group's centre up to this point based on the knowledge and views of experts, but it is now required for the system to intelligently centre and choose standard sensors without human assistance.

The usage of such a wide range of sensors is to infer or detect conditions around various items linked to the IoT and attached sensors. The IoT system contains multiple sensors delivered in terminals as well as M2M communication techniques. Consequently, it can be claimed that identifying the centre of sensors to be gathered in recognising this real-world scenario is advantageous to quick situational awareness.

The event frequency is examined in this study in order to establish the sensor data, which is the core of each sensor and the benchmark for sensor data streams for scenario identification, and the reported data stream is established as the reference data stream.

The following are included in this study. Related research are summarized in Section 2. Section 3 suggests a strategy for investigating data stream events in a constrained IoT context, Section 4 carries out tests and assessments, and Section 5 draws a conclusion.

## 2. Literature Review

With the advancement of computing technology and networking capabilities, data can be gathered from a variety of sensors and intelligent services may be offered. Many areas (Sung & Rhee, 2016) are using context awareness technologies to examine user behaviour and information about the environment. It has been suggested to employ middleware technology to act as a bridge between users and applications, sensing technology to gather context-specific data, and higher context-specific information technology(Jung et al., 2014). Situational awareness-based customised services contain algorithms for gathering sensor data and extrapolating higher context data utilising the system's APIs. This results in an increase in computation and an issue with resource waste when the number of concurrent apps grows, the number of linked API calls grows, and distinct upper-level context information inference algorithms must be run. Thus, a proposal is put out to gather and process situation information directly from middleware, infer higher situation information, and communicate it to an application to exchange sophisticated scenario information in order to address the issue of performance degradation (Sung & Rhee, 2016).

Real-time response processing and estimating the quantity or distribution of various data streams are challenging tasks. When the system's memory capacity is surpassed, it is suggested to lessen the burden for multi-window join in an effective manner. It was challenging to forecast tuple productivity when some tuples were discarded unless the distribution of join key values remained consistent (Gedik et al., 2007). As a result, rather than using the join key value of the tuples, the arrival order for the data stream of the tuple is used to estimate tuple productivity. The presence of the arrival order pattern in the multi-window join allows for efficient load reduction. The arrival order pattern of naturally occuring tuples is used to reduce load. It effectively addresses the issue of figuring out if a tuple may be joined based on the distribution of join key values. Even when the distribution between streams differs, performance is high if the join key value is unique or without repetition(Kwon et al., 2010).

The potential tree lattice structure, which is an observation grid, is used, together with delay insertion and pruning algorithms, to locate frequently occurring items in the real-time data stream. The methods of updating factors, updating numbers, delay-inserting, and choosing a group of

frequent items are used in the estDec methodology to identify a set of frequent things (Chang & Lee, 2003). To uncover association rules in the data stream, an association rule exploration approach has been presented. The association rules are formed by examining the observation grid for each rule. The association rules are classified into ordered rules and non-ordered rules. The order rule may be stated in the form of abcd, while the non-order rule can be expressed in the form of adbc, according to the dictionary order(Shin & Lee, 2008). Real-time data stream scenario is a term used to describe a situation when a robot is gathering data from its environment using a sensor. One can implement a robot's situational cognitive strategy by using the theory of association rules of data mining. The future behaviour may be predicted by creating association rules using the robot's stream data. A system structure that can apply robot context using a situation-action decision technique applicable to the robot's sensor data stream situation was proposed (Group, 2003). This is because the association rule exploration technique cannot be applied due to the specificity of the sensor data set that can be collected by robots(Gomes & Choi, 2008).

**3. Strategy for Searching Data Stream Events in a Restricted IoT Environment**

The issue that existed in the prior omnipresent environment was resolved with the development of the Internet of Things. Long-distance data transmission proved challenging in a pervasive environment, and the terminal's power issue remained unsolved. Situational awareness and intelligent services that operate automatically were thus not deployed. Situational awareness and intelligent services are now feasible in many industries thanks to the Internet of Things. The Internet of Things may be used in open spaces over a large region, and it is also conceivable to provide numerous intelligent services in remote locations where people cannot dwell or travel. (Kim et al., 2018)

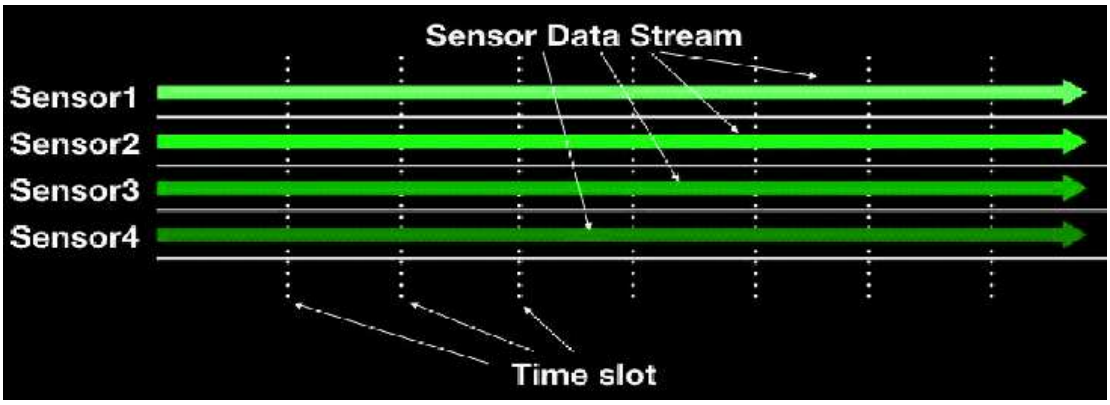


Figure 1: Stream of Data from Sensors

The choice of a sensor that is appropriate for gathering context information is crucial, and the effective use of sensor data that these sensors detect and report is also crucial. It may incur unanticipated expenditures for the IoT system to occupy the volume or weight that might obstruct the target area or object's ability to function naturally while trying to execute intelligent services in a spatially precise location. Consequently, choosing an appropriate sensor that is required for situational awareness is critical. It is also crucial to properly and efficiently interpret the sensor's output.

Instead of identifying the issue itself, sensors often react to the physical changes, chemical compounds, or reactions that are present in the environment. A substance or device that detects a physical, chemical, or biological phenomena is used by the sensor to acquire a fine current or voltage value. This value is then amplified to provide a numerical value that is acceptable to the user. Nevertheless, often, it is only quantified after detecting certain changes connected to the circumstance. The data collected and supplied by sensors may give a crucial basis for recognising the scenario itself. Thus, it is essential to thoroughly examine and make use of the data supplied by sensors that have identified various physical and chemical changes in order to raise the degree of situational awareness information.

In this work, it is assumed that in order to gain a higher degree of contextual information, an integrated analysis of heterogeneous data streams made up of sensors of various sorts is necessary. It is now important to link them, evaluate them, and play a central and standard function when several various types of sensors communicate their discovered data for a single circumstance. If so, a strategy for figuring out the primary function of data analysis that acts as such a reference is required.

To enable one of the sensor data streams to fulfil this function and to identify and make use of the

sensor data stream in order to recognise the circumstance, the following methods and processes are presented in this study.

1. As time passes, sensors continue to relay the data they have detected.
2. Each sensor's data that is detected and reported may vary depending on the time zone.
3. A criterion and a centre in connecting sensor data streams for context recognition are developed using a sensor data stream that demonstrates a notable difference between each sensor.
4. Combine substantial changes in the data stream that serve as the foundation for context recognition with additional sensor data streams that indicate changes in time.
5. To determine the scenario in the actual world, it examines the aggregated sensor data streams.

These techniques and processes are anticipated to be helpful while operating constrained sensing assets to identify diverse scenarios or to identify critical and urgent circumstances when working with constrained system resources. An easy way to recognise a condition using a sensor's data stream is as follows.

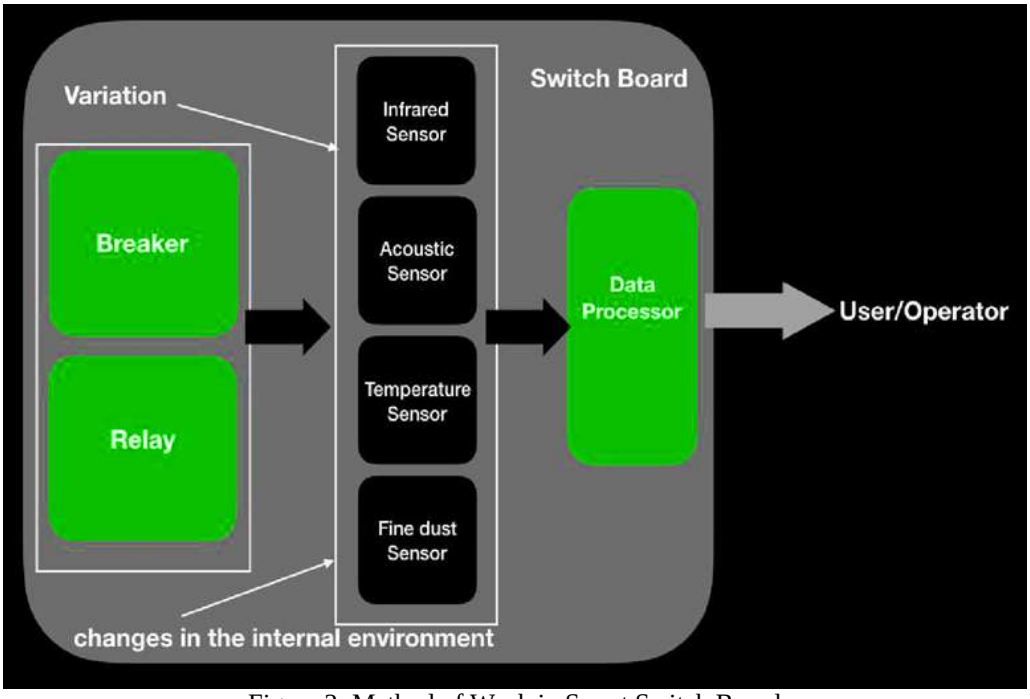


Figure 2: Method of Work in Smart Switch Board

1. To detect the scenario, k various sensors (s1, s2, etc. Say that sk. S = s1, s2 if S is a group of sensors. Indeed, Sk. S(t) = s1(t), s2(t), s3(t),... sk(t) if S(t) is the collection of data values measured at each sensor at each time t.
2. The occurrence of an event at each sensor at any given time t is determined. Sb = sb1, sb2 if Sb is the collection of reference values for each sensor. Indeed, sbk. Pn is equal to sn(t) / sbn (where n = 1, 2,..., k, t t) and is determined by a sensor (sb1, sb2,...) at any given moment. … sbk ) For reference value, via sensor (s1(t), s2(t), An event is considered to occur if the measured P value for sk(t)) is greater than or equal to 1.
3. Assume that event set E. The sensors (s1, s2,...) are used for any time t. e1(t), e2(t), and e3(t) are the events that were identified and reported as events following detection. E = ek(t), e1(t), e2(t), e3(t), etc. (However, 1 if en(t) is an event and 0 otherwise, where n=1, 2,...). …, k)
4. Among the observed values, sensors communicate the event value to the host.
5. Merge the event data that the host was notified of.
6. The event data set EDset is as follows when the event data set merged at random time t is e1(t), e2(t), and e3(t). EDset(t) = e1(t), e2(t), e3(t), e1(t), e2(t), e3(t), e1(t), e2(t), e3(t)
7. Each event data that makes up the event data set has a specific significance.
8. In each circumstance, a different event data-based situational recognition is used. A specific circumstance arises when yp for any value of p.

Each sensor in the continually incoming sensor data stream is a distinct kind of sensor. According to the circumstance, the sensors acting as centres

and criteria among these sensors may change. Depending on the types of sensors employed, the scenarios that may be detected and inferred by this system may be further varied.

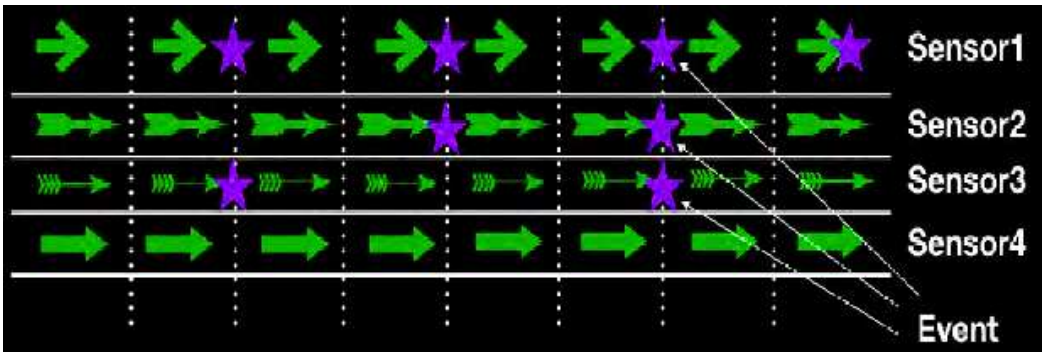


Figure 3: Streaming Data Events

In Section 4, sensors are used to test and assess the study's recommendations.

## 3. Experiment and Evaluation

This study's experiment showed the experimental procedure and outcomes of three novel detection targets that were created by merging each sensor.

**1. (Temperature sensor + Current sensor)**

A current sensor and a temperature sensor were used to find the breaker's operational fault. A test was done to see if an increase in current value and temperature that lasts even when the circuit breaker is not operating may be used to identify an error in the circuit breaker's operation at a time when the danger of deterioration is low.

After doing the experiment, it was feasible to see how the conductor degraded at 110 mA and 90°C. The breaker can identify operational faults before the conductor deteriorates since it is programmed to trip when the non-contact temperature sensor reads 70°C and the current sensor reads 90 mA. Each sensor produces a digital signal (HIGH) and inputs it to the AND gate of the logic circuit to detect a circuit breaker operating fault if the current sensor detects 90 mA or more current and the temperature sensor detects 70°C or more temperature. The experiment's result notice was configured to illuminate the red LED.

**2. (Temperature sensor + non-contact temperature sensor)**

Using a non-contact temperature sensor and a temperature sensor, an anomalous temperature increase of the conductor in relation to the temperature in the switchboard or facility was discovered. Due to internal and external circumstances, the temperature of the circuit breaker itself and the temperature within the switchboard rose, and a problem with the wire breaker was found. It was designed to identify a scenario in which the temperature of the wire rises as the switchboard's interior temperature rises. By creating an enclosed area, an experiment was carried out to raise the surrounding temperature. The experiment's findings showed that regardless of overcurrent, the wire's temperature rose exclusively in response to a rise in the ambient temperature. The criteria for identifying the rise in wire temperature brought on by an increase in ambient temperature were the initial ambient temperature, the initial wire temperature, and the later wire temperature. To detect an increase in wire temperature caused by an increase in ambient temperature and turn on a yellow LED, a digital signal (HIGH) was output from each sensor in this example and fed to the AND gate of the logic circuit.

**3. (contactless temperature sensor, temperature sensor, and current sensor)**

The goal of this invention is to use a current sensor, a non-contact temperature sensor, and a temperature sensor to detect an abnormal conductor temperature rise caused by the magnitude of the permitted current that fluctuates depending on the ambient temperature. The conductor's ambient temperature functions as a divisor of the permissible current. Hence, the allowed current reduces at high ambient temperatures near wires and increases at low temperatures. By adopting a condition where the wire is exposed to a high temperature, the current and wire temperature at a normal temperature (about 25°C) and at a high temperature (roughly 40°C) were measured. Conductor deterioration occurs at high temperatures around 95 mA and 100°C, while at normal temperatures it happens around 120 mA and 100°C. The overcurrent phenomenon, in which an anomalous current flow develops faster as the wire's permitted current falls, causes the wire's temperature to rise faster as well.

Even with a similar current value to when the ambient temperature is low, the wire's allowed current falls as the ambient temperature rises, and the wire temperature rises quickly. Using a temperature sensor of 40°C or higher, a current sensor of 80 mA or higher, and a non-contact

temperature sensor of 70°C or higher, the ambient temperature was detected. The green LED was lit in the example above because the digital signal (HIGH) was produced from each sensor and input to the AND gate of the logic circuit to output the final 1 (HIGH). This allowed the logic circuit to identify the rise in wire temperature caused by the rise in ambient temperature.

Evaluation: This experiment proved that the temperature sensor should serve as the focal point for situational awareness in a constrained enclosed setting. It was discovered that it is simple to identify the changing condition and abnormal situation of the interior environment while inferring the scenario based on the temperature sensor.

## 4. Conclusion

In order to increase performance while trying to detect circumstances in a constrained IoT environment, multiple types of heterogeneous sensors were utilised in this study. Sensor data streams produced by each sensor were then used to infer or recognise scenarios.

The issue was inferred by aggregating additional sensor data streams based on sensors that commonly show incredibly noticeable changes after comparing the values given by each sensor by time zone. Research to choose high-quality sensors that contribute steadily to situational awareness and protect the sensing data is anticipated to continue in the future.

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