Intelligent Integration and Collaboration of Interconnected Systems

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Abstract:

In this paper we will discuss the latest technology with respect to intercommunication between sensors, devices and people, and how those components can be best integrated to serve a larger purpose that can include future planning or modernization of the city of the future and how to best serve its citizens by creating intelligent and reactive systems.

We will introduce you to a variety of solutions that are used to detect any changes. We will also describe how the collected information is passed on to awaiting systems that either monitor or react to a given situation and how these systems can be best interconnected either by using their own proprietary functions or those functions provided by other sources. Finally we will discuss methods and solutions that can leverage the integration and collaboration of these systems to provide either reactionary recommendations or solutions where the system itself reacts to a given situation autonomously without the need of a user.

Keyword: intelligent, solution, integration, collaboration, data

Introduction to Intelligent Collaboration of Data and Sensors

Acquiring external data has evolved from its origins of data entry that is entered manually whether on paper or into a machine. Storage, indexing and retrieval was very time consuming particularly if the data was originally collected by a different entity which would need to retrieve the data at a later time. Analysis of such data was also very time consuming, as it often involved not just acquiring and analyzing the data, but often times it required understanding the conditions of the environment where and when the data was collected. This form of analysis involved obtaining a separate set of data which, if it did not exist, made it difficult to derive a valid or complete conclusion of the analysis.

There are many different types of data collection. Those that are manually acquired such as images, video text, audio, etc. Then there are those which are automatically collected, i.e. Radio Frequency Identification (RFID), bluetooth, wifi, chemical sensors, radar, GPS, etc. The collection of data, whether manual or automatic, is then stored in a data storage system, most of the time in a database but can be in various formats and mediums.

Solutions that use these type of sensors can take many forms and exhibit various results. All of which are based on the needs of the system. Early sensor based systems served purely as data collection, storage and retrieval. Bar code scanners used in grocery stores and inventory companies are good examples of these types of systems. As memory and computing power increased, so did the solution systems and their functionality. The traffic camera is one example of this increase in computing power[1]. Another example which exhibits this power, that has grown recently, is that of real-time information[2]. Systems such as GPS navigation, dashboards and weather condition monitors have various types of sensors spread out over a large area that can acquire, monitor and report any information in a more intelligent fashion. This allows less processing to occur at the centralized system, so that any extra computing that might be needed can be done in a more efficient way. The next section discusses the methods of how these sensors and monitoring systems are interconnected and configured.

Methods of Interconnecting Data Collection with Monitoring and Reactive Systems

Now that we have an understanding of how data is collected and stored, we will describe how an intelligent system is designed and created in order monitor and react to given situations. The first step is to ensure that the data is accurate and valid. Collaboration between sensors and systems must contain some data integrity models in order to know whether information does not contain false negatives or positives. Once the data has been validated then analysis of the data can be initiated in order to provide confident recommendations or reactions. However, in most cases, once the data is gathered most systems are limited to having some human interaction such as analyzing or determining a solution to a given problem[3]. With technologies such as artificial intelligence, machine learning, natural language parsers and analytics, it is now possible to have a system not only analyze a given situation but can also provide recommendations based on the vast knowledge base accessible by the system[4]. Example of such a system is described in the Results section of this paper. Recommending a solution is not a simple task. When people make recommendations the usual methodology is not only to identify a solution to a given problem, must one must also be able to have a confidence rating associated with each solution. Especially when there are more than one solution to a given problem or if the solution was derived from valid sources. The system itself must also have this built into its steps prior to making a recommendation or at least inform the user of its confidence on the recommendation.

Results

IBM's Watson [5] computer is an example of how an intelligent collaboration of data provides information or recommendation to benefit the end user, which in this case is the healthcare provider. The analysis of data is conducted by using specialized algorithms that can understand the meaning and context of various forms of data such as human language (medical records, research papers, etc.), images (MRI, X-Ray), etc. Watson then provides the analyzed data to the decision makers, in this case physicians and nurses, which helps them make intelligent diagnosis and conclusion. Included with the recommendation is the level of confidence so that the healthcare provider can make a more informed decision.

An example of a system that reacts to events is the Sun Pass system[6]. Sun Pass is an RFID system which is used to collect tolls on certain highways without the need of toll booths or attendants. It was developed to minimize traffic conditions where vehicles had to stop and pay a toll attendant which would cause traffic delays to commuters. The Sun Pass system is a collaboration between two separate types of systems. One of which is centralized and the other ad-hoc. Both systems also vary on how they communicate. The centralized system communicates synchronous whereas the ad-hoc system communicates asynchronously.

Conclusion

In this paper we described how collaboration between systems and the data they collect can benefit various different issues and provide solutions intelligently. Using these intelligent systems one can design and implement solutions that can benefit various industries such as healthcare, city infrastructure, logistics, manufacturing, etc. which can lead to a smarter planet where its citizens can live in a safer world.

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