Behavior analysis system

Iot or internet of things is the study of combining electronic devices with various systems and making a certain device which connects with other devices and shares data. Nowadays IOT is used for various activities such as monitoring agricultural process, delivery of products and even in heavy work such as national security and aero exploration. The most use that has been proven to be effective in IOT is monitoring any kind of activity and predicting its behavior. In China the government has already implemented this behavior analysis system in their CCTV cameras for the safety and management of their people.

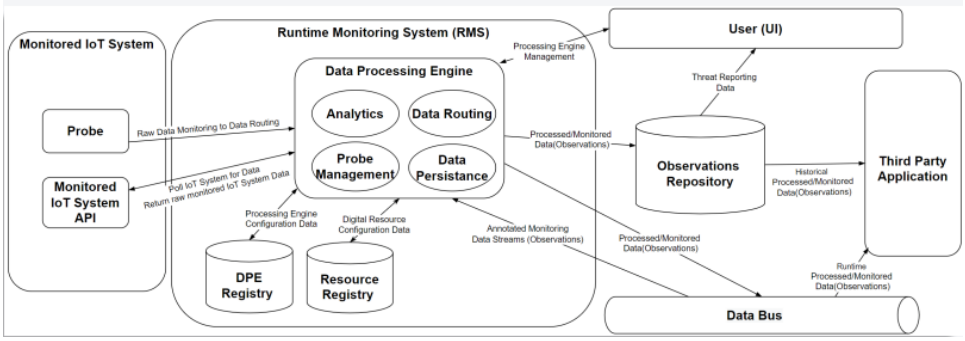
To create a successful and effective behavior analysis system, we need various hardware resources which all play a crucial role in the functioning of the system. Cameras, sensors, network infrastructure, data storage system, processing system and alert system are the basic requirements for the system. Once all these hardware are integrated it creates a proper running system which is ready to be deployed. But like everything it's not easy to be applied in the real world. The real world is full of complex things and unknown variables and as such we need to train the system by providing data and conditions. It is the most complex and important part of the system and it makes sure that the system is running properly.

The microcontroller acts as the brain of the system which is responsible for processing the vast amount of data that is generated by the sensors. Since there are various sensors and each sensor has a specific task which helps in overall accumulation of data it is very important to have a proper microcontroller. There are various choice for microcontroller such as Ardino, Raspberry pi and sometimes even custom made microcontrollers or dedicated microcontroller units. How to choose a microcontroller is usually based on the fact how energy efficient it is and if the processing power is suitable or not.

With proper hardware and a microcontroller to process the data what we now require in a mode of transport for the data. It can basically be done in two ways either using cloud computing or edge computing and sometimes hybrid between both. Communication modules are essential for uninterrupted transmission of data between the sensors and the processing device or servers.

The process of choosing communication module is dependent on various factor such as range, power consumption and rate of data transmission. Wifi, Bluetooth, loraWAN, zigbee are few of the communication module that we can consider.

Raw and unprocessed information is called data. Data is the essential information that plays a vital role in how the system behaves. Even if we have completely same system setup one might perform better than the other on the basis that data is not diverse or the machine cannot make decision on the basis of lack of information. Camera captures the visual data which helps the system to recognize certain gesture, facial expressions and movements. Microphones record audio information and detect sound vibration, tones. Motion sensor, Infrared sensor, pressure sensor and other sensor contributes to further data that the system may use give the system an adequate amount of data. What this does is it gives the system various choice to choose from and does not have to depend upon a certain information to make the decisions. This leads to a prompt decision and response which plays a vital role in the effectiveness of the system.



The figure above shows a system that can be used for data collection and publishing into monitoring platforms.

The process of data acquisition involves the continuous monitoring of the data acquired from the camera and various sensors. This collected data is unrefined and full of unclassified information which has to be refined and prepared for certain scenarios and the unrelated data should be managed properly for future reference.

While managing of data is crucial but we can not ignore data transmission as well for it is as important if not more than data management. Wireless transfer of data is one of the most effective and efficient way of transferring data. The choice of means of communication mostly depends on the the requirement of the user and the project.

For short range application Wifi and bluetooth are mostly used. Wifi provides high data transfer rate which is helpful for real-time analysis while bluetooth uses low power which is helpful for energy efficiency. For longer range and low power consumption zigbee and lorawan are more suitable. Zigbee is well suited for medium to short range communication making it idle for home environment. LoraWAN helps in long distance communication with low power consumption which is helpful in agriculture tracking.Cloud based storage and processing solutions further enhance data transmission capabilities. Platforms such as Amazon Web Services(AWS), Microsoft Azure, and Google Cloud offer scalable and reliable infrastructure for storing and processing large volumes of data. These cloud platforms enable remote access to data, allowing for centralized analysis and monitoring of behavior across distributed sensor nodes.

Machine learning plays a critical role in the response of the system. The human behavior has almost infinite possibilities for action. All the actions are random and non sequential which brings a layer of sophistication to the analysis and management of the data. Various machine learning modules have been created and deployed for this task as it is a huge endeavor and by no means simple .Neural network which is inspired by the structure of the human brain it has proven particularly effective in

capturing human like behavior data. The process of machine learning involves training various models in various scenarios. The input data is paired with certain behavior category. In the training phase the module should be introduced to as many as possible scenarios for effective use. Continuous learning is a key aspect of behavior analysis systems as it understands human behavior over time improving the accuracy.

Microcontrollers also known as the brain of the system is responsible for processing data. The ARM cortex-M series processors are widely used in microcontrollers for their balance of performance and energy efficiency. For more powerful processing or dedicated servers handling extensive data, processors like intel core i7 are used. These processors offer high computational power for running complex algorithms. The working mechanisms of these processor chips involve executing instructions and computations to process and analyze data. Microcontrollers operate on a reduced instruction set computing (RISC) architecture which emphasizes simplicity and energy efficiency. This makes them well suited for embedded systems with limited resources. While processors like Intel Core i7 utilize complex instruction set computing (CISC) architecture which allows for a broader range of instructions and capabilities. This architecture is advantageous for high-performance computing tasks such as running machine learning models on large datasets.

The behavior analysis system is a project that is made to help the people and give them a sense of security and comfort. It is used mostly in security and surveillance, healthcare monitoring, smart environment, customer analysis, machine interaction and most importantly in education. While it is true that it has helped in various sector but it has also raised some concerns.

Enhanced security:

Advantage: By using the behavior analysis system threat has decreased and reducing crime and allowing for the concern authorities to react quickly and in some cases even before the crime has occurred.

Disadvantage: At the same time privacy concern due to extensive monitoring may occur.

Improved Healthcare response:

Advantage: It leads to prevention of illness and better management of chronic illness.

Disadvantage: While data security and patient confidentiality may occur

Customer analysis:

Advantage: It helps to understand the market and increase the sale and customer satisfaction

Disadvantage: It creates concern about privacy and lack of consent

Machine interaction:

Advantage: Improves human computer interaction by understanding user behavior and adapting interfaces accordingly.

Disadvantage: Need for accurate sensors and reliable algorithms may pose a challenge in achieving seamless human computer interaction.

Education:

Advantage: It has led to personalized learning experiences, improved student outcomes, and a more adaptive educational environment.

Disadvantage: Need for robust infrastructure and training for educators.

Countries like the USA, UK, China, Singapore, South Korea and various European countries have already adapted this module of surveillance and the public has had mixed response in some countries while very positive response in others. For instance, London has an extensive network of surveillance cameras known as the "Ring of Steel". The UK government has faced criticism from civil liberties groups regarding the impact on individual privacy, but security agencies argue that such measures are essential for public safety. While in Singapore the public response has been relatively accepting, with an emphasis on the benefits of technology in creating a smart and safe city. And in the US response from the public has been mixed with concerns about privacy and potential misuse of surveillance data.

While few countries have succeeded in applying this system in their normal use, not all the countries in the world can afford to do so. This is going to be one of the major challenge in the implementation of behavior monitoring system. While the resource is one problem convincing the people about how their data is being taken and used is entirely different. People aren't fond of the idea that their activities are being monitored and when it is collected and used for reference people would be more adverse to the idea. And the major thing that is required for the compilation and proper running of the system is data. Human behavior is complex and random and as such no amount of data is ever enough and it is believed that if we do not share data within various countries we would take ages to get a proper and effective system which will pose a significant problem.

In order to get more accurate data and efficient data it is necessary to introduce wearable devices which can track the activity of the user and send the collected data into the server or wherever the data is being accumulated, classified and used. Since the wearables will be allowed to monitor each individual personally and create a pattern that will lead to an increased amount of data and in times of trouble or if someone decides to start trouble the system would be able to detect the irregularity and promptly send the alert to the concerned authorities.

In conclusion, for successful development of a behavior analysis system we need proper hardware, data acquisition and transmission techniques, proper storing and classification of data, and a highly trained machine learning algorithm. The combination of sensors, microcontrollers, communication modules and processors help in understanding the complexity of human action which have unexpected amount of variables in it. For a system to be effective it should run as intended and be easy to apply but in the case of behavior analysis system it will be challenging to acquire the required infrastructures. We have to keep in mind that improvement of any system can be only done if it is available everywhere and is being used constantly.

References:

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