COM-IOT TECHNOLOGIES

Introducing I-TRAC

Artificial Intelligence for Intelligent Security & Crowd Management

2019

COM-IoT Technologies

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Introduction

In this document we describe COM-IoT's novel solutions that uses latest technologies in artificial intelligence (AI) and internet of things (IoT) to offer solutions to very important problems in the daily life that are related to security and traffic safety.

The importance of those applications comes from three main factors

1- How frequently they are used in our daily life and how important they are?
2- How hard it is to collect clean and helpful data, and how can we use it?
3- How scalable that solution is to monitor a building or an entire city?

Those three questions are answered in details in our solution section, I-TRAC uses LiDAR technology to deal with the very important issue of tracking and following wanted people in public location whether they are closed or open areas and it's now patent pending.

It's important for us to mention that each of these solutions that will be illustrated have been deployed for permanent use or proof of concept (PoC) purposes in very important locations like Gitex, Presidential Palace in Abu Dhabi, Wahat Al Karama, Dubai Airport, City Walk and Dubai Future Accelerators.

I-TRAC suite

I-Trac is a suite of intelligent security and crowd management solutions, each can be applied separately or combined together.

As mentioned above I-TRAC deals with the issue of tracking and locating an unwanted person not just giving alerts of his arrival, this gives security personnel and police officers instant information about the wanted person's location at any given time, and it offers other functionalities as well to help the main objective which is intelligent security, following a diagram describes I-TRAC capabilities

Key features:

1- Entries and Exits Monitoring (LiDAR sensors)
2- Intruder identification & tracking by AI-based sensor fusion (cameras & LiDARs)
3- Black list alerts
4- Traffic density/heatmapping (LiDARs)
5- Accurate people/crowd counting for crowd management (LiDAR sensors)
6- Perimeter protection with no/low false alarms by AI-based sensor fusion (cameras & LiDARs)
7- On-demand data for (track lines or counters) retrieval & analytics
8- Assigning a unique ID to EVERYONE not on the database and storing each person's track line for on-demand retrieval if required by AI-based sensor fusion (cameras and LiDARs)

System Use Cases

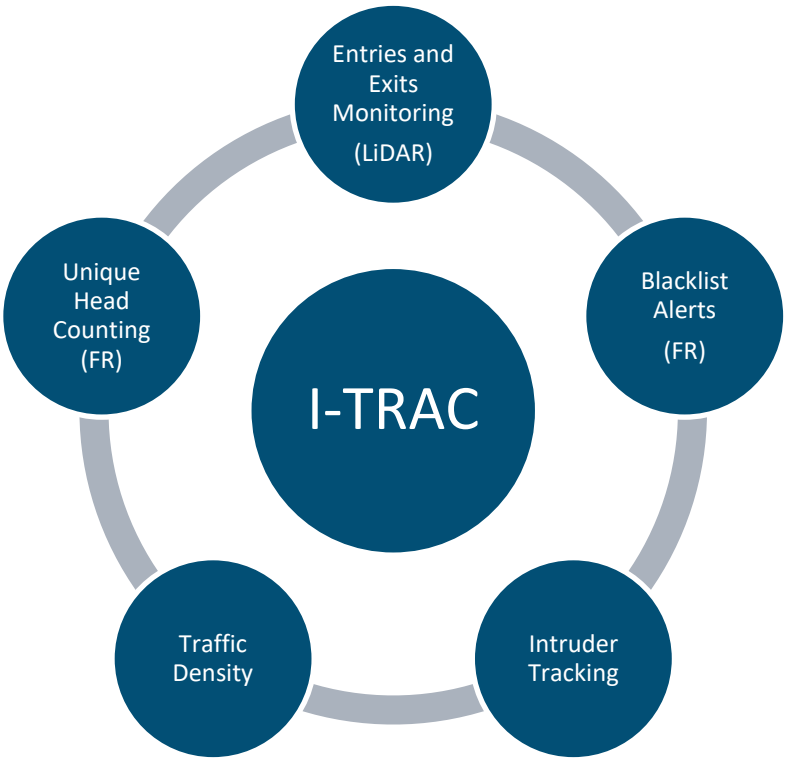


Figure 1 - I-TRAC Use Cases and Capabilities

The whole system is using a series calibrated LiDAR and camera sensors (sensor fusion) that does all those functionalities simultaneously without a special setup or equipment for each function, following a detailed description of each of them.

Function	Description
Intruder Identification & Tracking U.S. patent pending	If a wanted person enters a building or a specific location, I-TRAC's installed camera will be able to recognize his/her identity, fire an Alert to the authorities and then the LiDAR sensors will track him wherever he goes. It doesn't need a special camera or LiDAR to everyone like normal tracking techniques using camera, the same camera and the same LiDAR will be used to everyone.

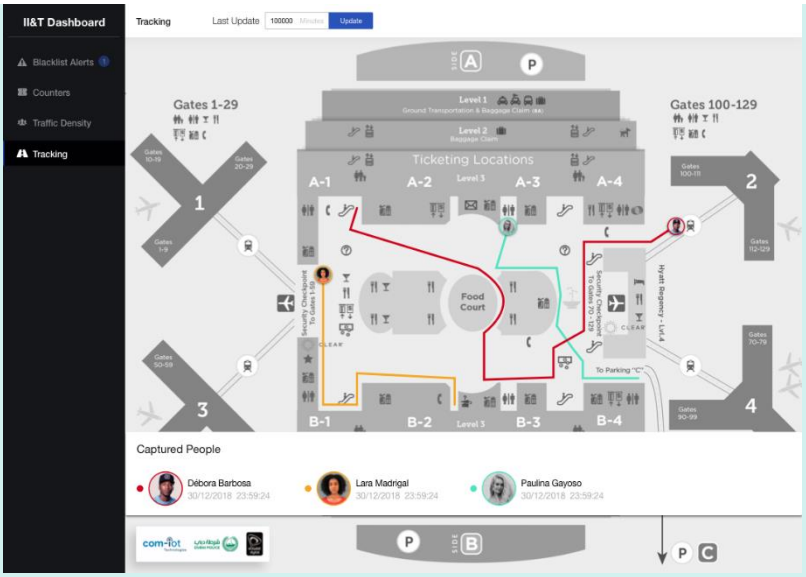


Figure 2 - Intruder Tracking Illustration

The above illustration shows an I-TRAC demo our solution, there are many people visible and given unique ids but only identified people have been given different colors.

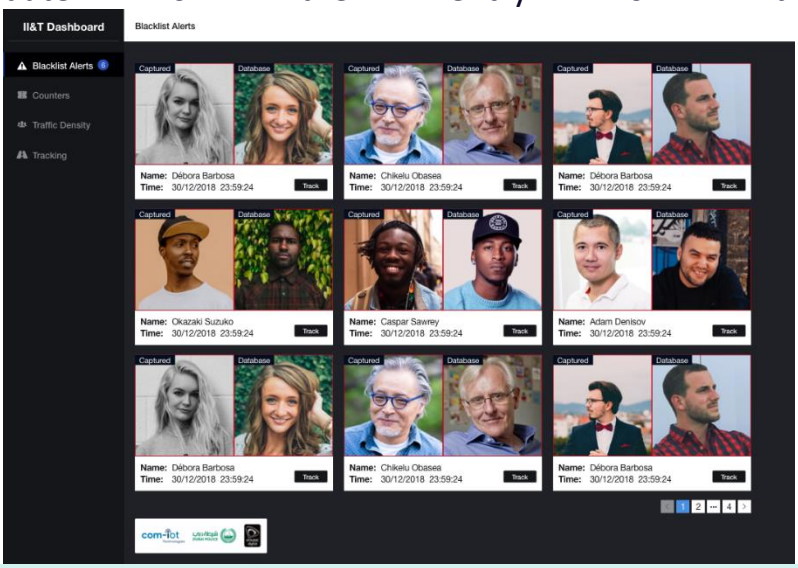
This solution are highly customizable, it has been ported to two dashboards already with different UIs.

A powerful point of using LiDAR in tracking is that it isn't prone to different light, weather or temporary conditions, they can work in the dark with the same performance as in the light.

Blacklist Alerts

I-TRAC also is capable of giving alerts after the entry of an unwanted person, this alert is crucial to make the security personnel give more attention to the track of the intruder and start following him.

It'll also report an image showing his arrival with the date of the entry on it.



For many organizations and buildings, it's very important to know how many people entered in any given day to compare this number to their records.

This feature is capable of reporting to a very high accuracy this number backed with a dashboard that shows all faces entered in a specific day.

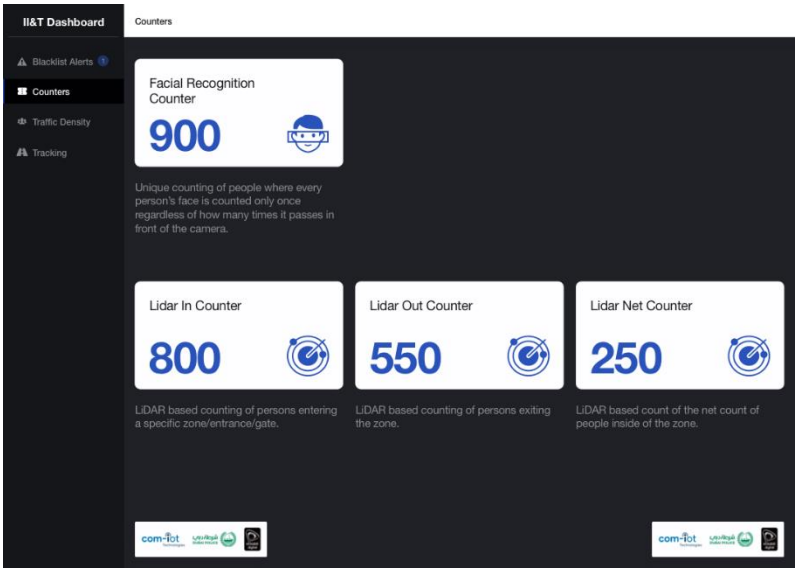
Unique Head Counting

Figure 3 - Unique Head Counting in Action from Wahat Al Karama

The above figure shows anonymous faces counted from I-TRAC's deployment on Wahat Al Karama.

This feature will make it much easier to investigate any incident without the need to watch hours of recorded videos, the investigator will simply review who entered and when.

Entries and Exits Monitoring



For each important location or building there are security personnel to monitor and guard each door, whether that door is an entry/exit or an internal door that leads to a secured room that only specific people can enter.

Also, managements of places that deal with large number of people every day need to know which gate is used more so they can secure it with more equipment, in malls, they need to know so they can price ads on those gates accordingly.

The use of facial recognition cameras for these purposes might be limited by light conditions and sun light, while these locations need to be secured all the time, the LiDAR technology is vital here, as mentioned before, LiDAR is independent on all those conditions.

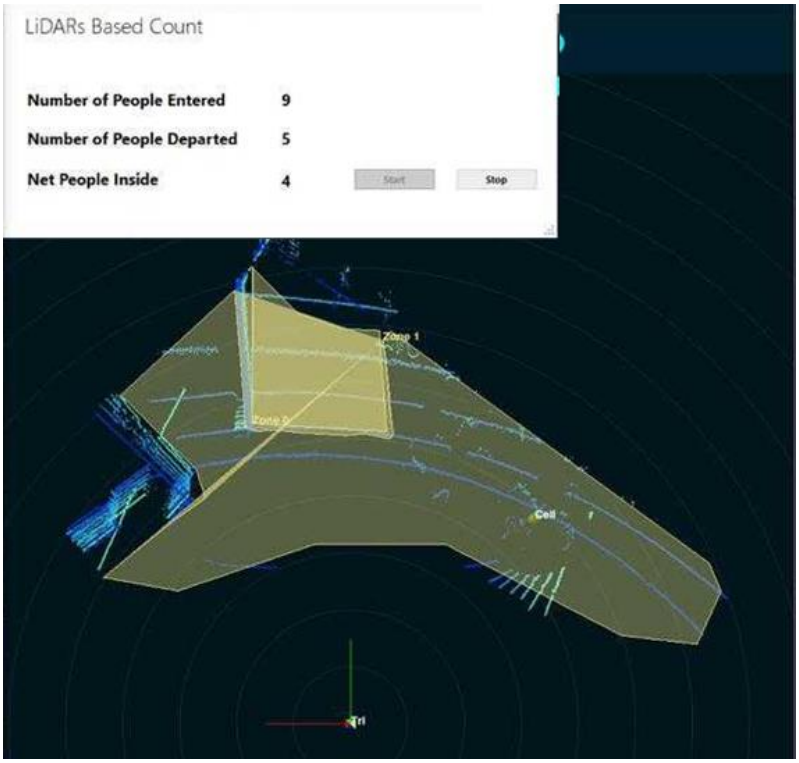


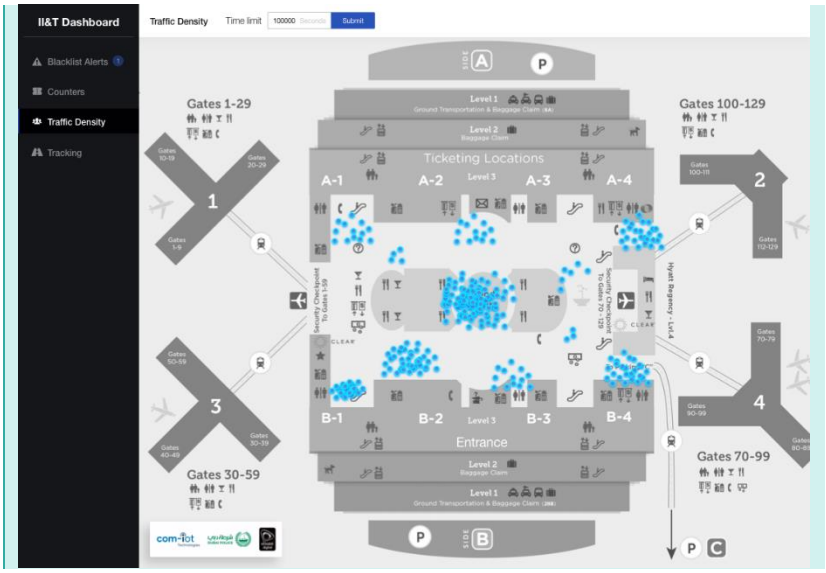
Figure 4 - LiDAR View and Counting from WAK

The above figure shows the view from the LiDAR and the monitored gate at Wahat Al Karama with numbers show the traffic through that door.

Traffic Density

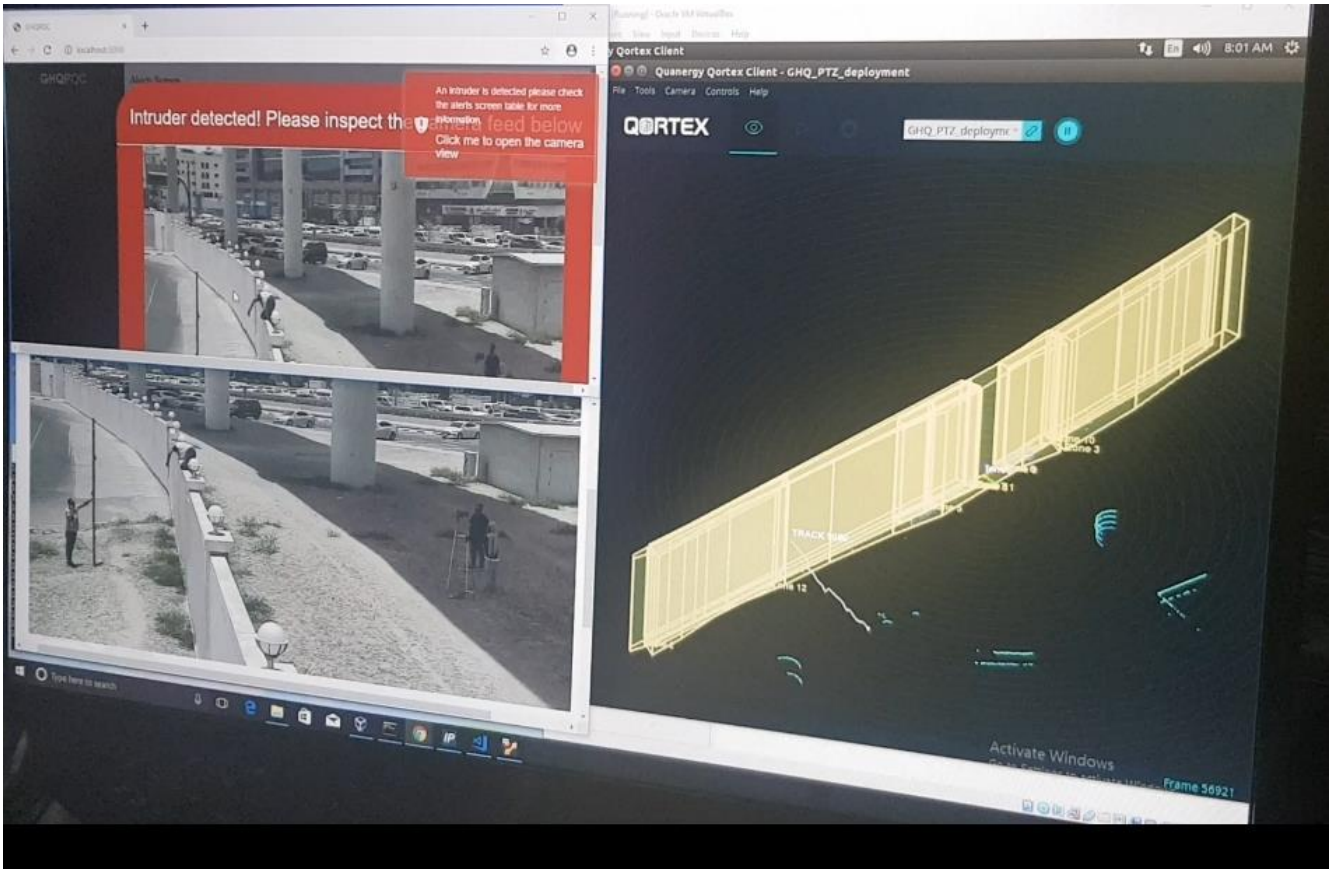
Traffic density solves the problem of knowing where people are gathered at any given time at large locations like malls or airports.

This feature is important for security personnel to detect sudden gatherings and for analysts to know which places are more important and frequently visited more than others.



Perimeter protection

Perimeter protection has traditionally been done by security personnel manning the required perimeter, or by CCTV monitored by security personnel. Lately some attempts have been made to automate the process by utilizing cameras with intrusion detection analytics, but these have failed badly due to false alarms. Camera feeds are 2-dimensional and that results in a variety of false alarms generated by non-intruders touching the 2-D detection zones such as trees, cats, birds and other objects. The solution is I-TRAC's LiDAR-based AI solution.



With I-TRAC's unique LiDAR based AI solution with camera/LiDAR sensor fusion you can say goodbye to false alarms.
The system detects intruders attempting to jump a fence/wall, fires an alert to the authorities on them, and with calibrated camera/LiDAR, it records a video of the event. With on-demand data retrieval, the system maintains records of ALL intrusion attempts from all covered locations.

Crowd management

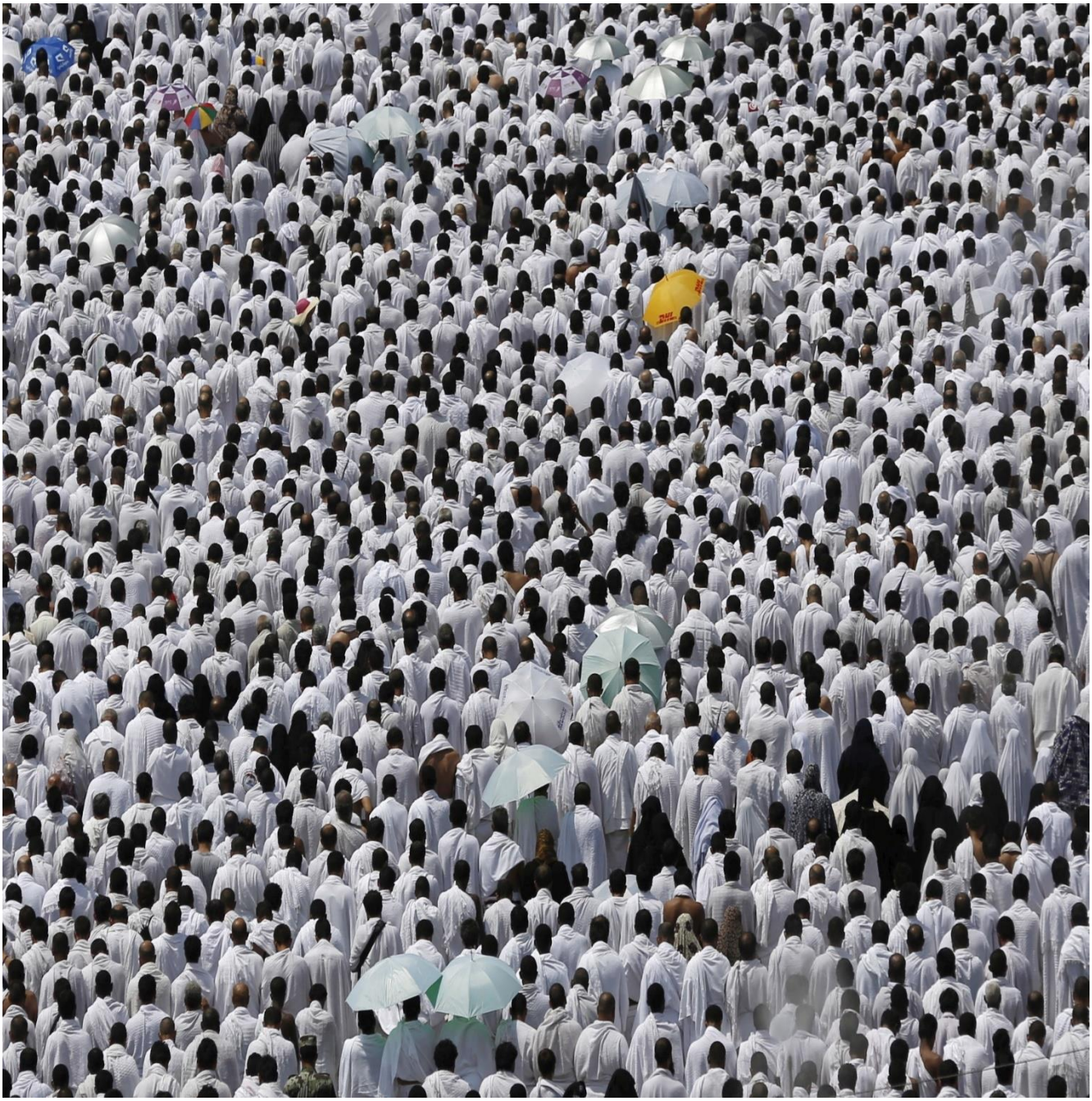
The challenging part comes in organizing crowd movements. The main element required for this to have an accurate count of the crowd at any location required at any given time.
This organization would ideally need to

1- Stop people flowing towards crowded gates or bottlenecks.
2- Redirect people towards another location or gate.
3- Send live alerts for overcrowded locations or locations are about to.

4- Provide highly accurate counts of how many people in a certain location.
5- Provide live data from all gates and open spaces around the two mosques.
6- Locate missing people using their photos in camera enabled locations.

Multiple endeavors had been made towards that objective while all still are subject to many vulnerabilities as most of them are 100% camera-based solutions and the rest depends on data from distributed security personnel which can't provide accurate counting data for example and they suffer from some vulnerabilities like

1- These systems don't work well at night or no light conditions.
2- Cameras can't work simultaneously on 360^{o} thus they don't provide full view insights.
3- Cameras suffer from bad weather conditions like fog and dust.
4- Cameras need so many officers working on it to analyze the data they send, no big decision making is done autonomously.
5- No handover between cameras at large places, each camera would send the data it sees but they would all integrate (or calibrate) together to see the same object
6- Cameras' accuracy at crowd counting is very poor.



LiDAR Sensors offer a much higher counting precision, better control and view to solve those issues and provide better insights and real decision making, following is a demonstration how.

System Architecture

As mentioned before, on of I-TRAC's powerful points is that it's extremely flexible and can be fully or partially deployed in most of the locations, a high level architecture will look like the following diagram

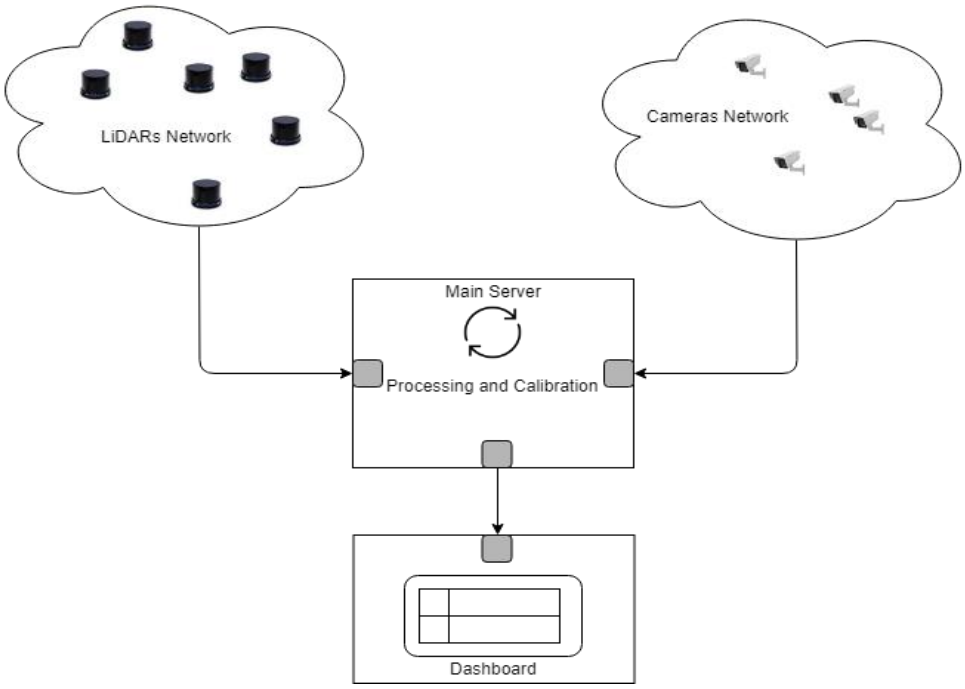


Figure 5 - A High Level Diagram for I-TRAC

From the above illustration we can know that I-TRAC doesn't require special networking, all the components can be add easily to the internal network at any given location or a new and simple network can be established.

I-TRAC Conclusion

I-TRAC is US patent pending as it's the first solution that uses the fusion between LiDARs and cameras for security purposes, the following diagram shows multiple factors of why I-TRAC is needed

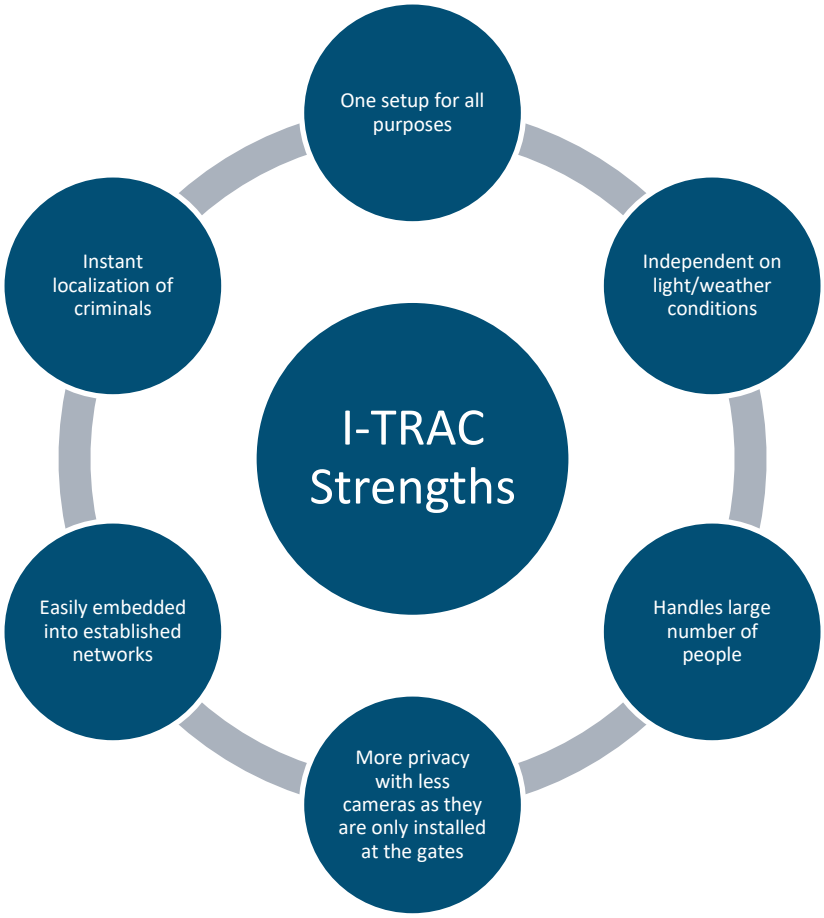


Figure 6 - I-TRAC Strengths