

Smart Technologies and an Approach to Eliminate Energy Wastage

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Abstract-

Emerging technologies can be used to tackle the existing problems with a smart approach. Smart Sensing technologies in combination with IoT and other technologies can be used in our daily environment to eliminate wastage of resources, conservation of electricity and also to be used for the welfare of the public. In this paper we will look at an approach to answer some of the existing problems around us. Saving electricity and preventing its wastage is indirectly putting reducing stress on our natural resources and thus helping in sustainable development.

Keywords-

Smart Sensing Technology, IoT, Cloud Platform, Automation, Data Interpretation, Machine Learning, Data Analysis

Introduction-

The world is now calling out for smart devices, from cell phones and televisions to everything around us, has turned into a smart device. All these smart devices are aware of their physical environment and adjust its behaviour accordingly with any change in it. It was all made possible with the commence of smart sensors. These sensors gave rise to the technology known as smart sensing technology. Smart sensors take any change in its observable physical environment as an input, process it and plan out its action based on the predefined algorithm and signals the associated acting device. These smart sensors are the combination of hardware and software, brought together to draw out the best results with the least cost and effort. It consists of a digital interface that functions on the data and software stored in its memory, which commands a signal handling unit on the basis of input received by the sensors to give appropriate output.

Smart sensing technology also favours the multi-sensor system where more than one sensor acts over the same physical environment, collecting data about its different aspects depending on the nature of the respective sensor. This system is favoured by the argument that it will bring much accurate and reliable insights about the environment as it will be a cumulative result of processed data that cover broad aspects rather than a single one.

Literature Survey-

Growing trend of IoT has led to a massive uprise in the application of smart sensors everywhere from industrial processes, security systems to home appliances. IoT promotes the system of interconnected devices that acts upon understanding the need without involving any human interference or manual command. The combination of IoT and smart sensing technology has led to the automation of our basic day to day activities. Automated doors in shopping malls and hospitals, threat alarm systems, level sensors in industries etc are some of them. Even in medical instruments these sensors are used for ensuring proper function such as sensors detecting proper flow of fluid, and blood, and a soil moisture monitoring sensor is used in automated irrigation systems.

Scope of Application-

When it comes to the reduction in wastage, these technologies are playing a good role by designing smart systems for homes that turn off appliances themselves when nobody is in the room or in any similar circumstances that could have led to the loss of energy. Scope of application of such sensing technology and network of interconnected devices can be made more efficient with the combination of other technologies such as cloud computing, deep learning, machine learning, data analysis, image processing etc. An intelligent blend of these emerging technologies can be used for conservation of energy, avoiding unnecessary consumption of digital memory, improving civil security and can also be helpful in crime investigation. There are endless opportunities for application of such advanced technologies.

Problem Identification-

Works on eliminating the wastage of electricity inside the home or in an indoor environment are going on. But the problem arises when this work gets limited to the indoor environment only. Scope of eliminating wastage of energy with the help of smart sensing and other evolving technologies needs to be expanded to the outdoor environment. Like in India, street lights are lit up from sunset till the sunrise, whereas except for the metropolitans, or some areas of a city and highways, in most of the local streets and roads in a small town or even in a city, nobody is present outside their home, and unnecessary electricity is being consumed and wasted. Power ratings of street lights in India vary from 35W to 200W, however the average power rating of street lights is taken to be 80W and there are countless numbers of such poles..

Apart from energy wastage, unnecessary memory consumption can also be tackled both in indoor as well as outdoor environments, by confining the capturing of data by device for the time only when a meaningful insight can be drawn from the data being collected. Let us take an example of a shopping mall or a surveillance system of any apartment or residence, where the security cameras are running throughout the day and collect data all the time. But most of the time, they are collecting the videos which are of no use, meaning when nothing of our interest is taking place. It will avoid useful data being washed up due storage issues.

Suggested System-

A multisensor device can be designed consisting of non steady sensors, complimented by IoT for connecting to other devices and along with a cloud platform for storing data. This data then can be analysed applying machine learning and data science algorithms whose insights drawn can be used for understanding the nature of the subject and can also be used to provide various services.

Methodology-

Following will be the steps involved in this method-

1. Detecting motion with the help of infrared sensors
2. Triggering the IoT connected device
3. Storing data in cloud platform
4. Turning off the triggered device
5. Data management
6. Analyzing data and drawing insights

For Street lamps/lights-

Detecting motion with passive infrared sensors

Passive infrared sensors detect motion with the help of infrared waves released by the human body due to body temperature. For detecting this motion a device can be designed that can be mounted on the pole for detecting motion. Roads in India have two kinds of lamp poles, one that are placed on the corner of a road, and other that are placed along the median strip in series. In both the cases the design of the device could be similar with some minor differences.

- **Designing hardware of the required device**

The device to be designed should have an infrared sensor, that should not stay stationary but have a range of movement covering the area to be taken into consideration. The direction of movement will depend on the position of the pole. Poles that are on either side of the road can detect motion in a circle around it. Although not a complete circle but an area between semicircular and a 3/4th circular area. So the movement of the sensor will be in an arc. Whereas the poles that are in the middle of the road can detect motion to a comparatively larger distance, and for this the movement of sensors will be along the road. In order to avoid covering a short semicircular area by poles on the side of a road or corner of a street we can use the same device in a pole halfway the street in both directions.

Checking the required condition

Infrared sensors detect all kinds of motion. But our focus is on just detecting a motion associated with a human or a vehicle. We don't want our system to get alarmed on detecting motion of a dog or a cat. For this instead of using a conventional sensor, improvised arrangement of sensors can be used having multiple sensors targeting different levels so that a better recognition can take place.

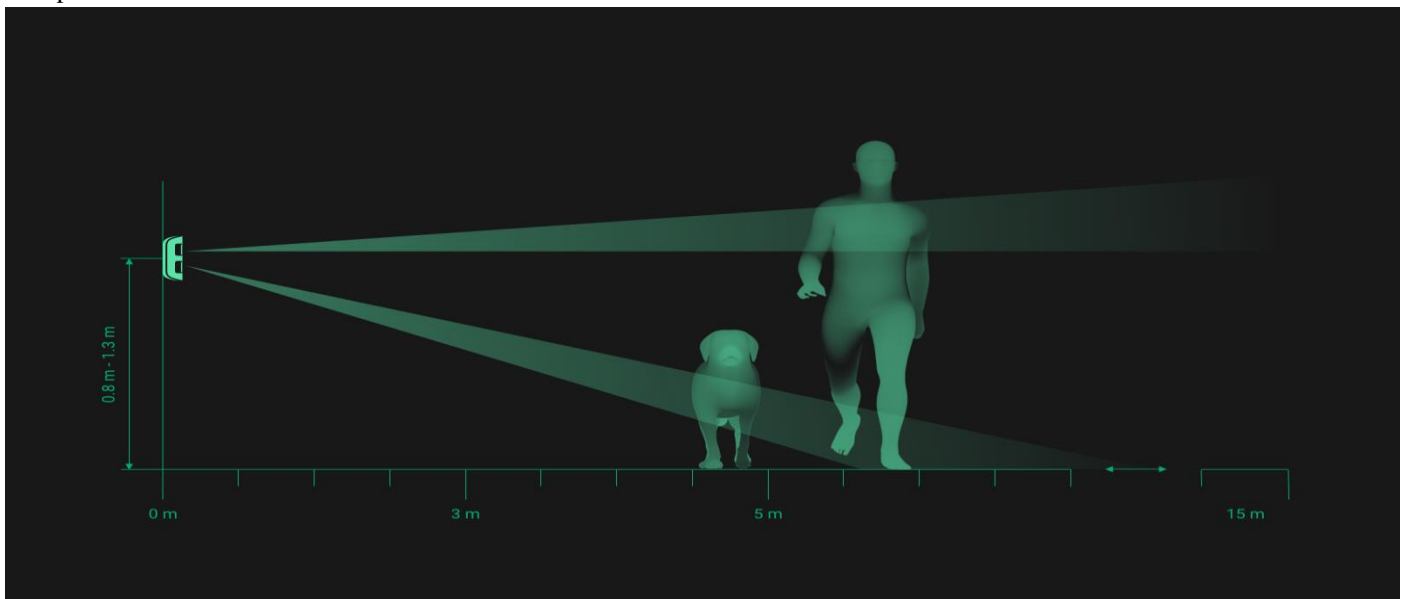


Fig. 1: Representation of sensors detecting at multi level for efficient prediction

As highlighted in the above image, multiple sensors focusing at different levels can be used. In this way we can come to the conclusion that we need to trigger activation signals when the motion has been detected at both the levels. More than two sensor systems can also be designed as per the requirement or what needs to be detected. An ultrasonic sensor can also be placed in parallel to these infrared sensors in such a way that it can measure the distance of the disturbance. This distance can be helpful as the difference between the levels of detection will decrease relatively with distance. So the combination of both the inputs i.e., distance and difference in levels can be used for more accurate detection. In this way, we can eliminate the chance of transmitting an unwanted alarm and the system will then be alarmed only in response to a human or a vehicle in motion only.

Triggering the associated device

With the help of IoT, we can connect the triggering device that detects the motion and device to be triggered. The system will consist of active poles and passive poles. An active pole will be the pole in which the sensing and signalling unit will be present that will detect and transmit the triggering signal, whereas passive poles will be the poles with the receiver unit. Even a single pole can act both active as well as passive depending on the location of the pole and instancial circumstances.

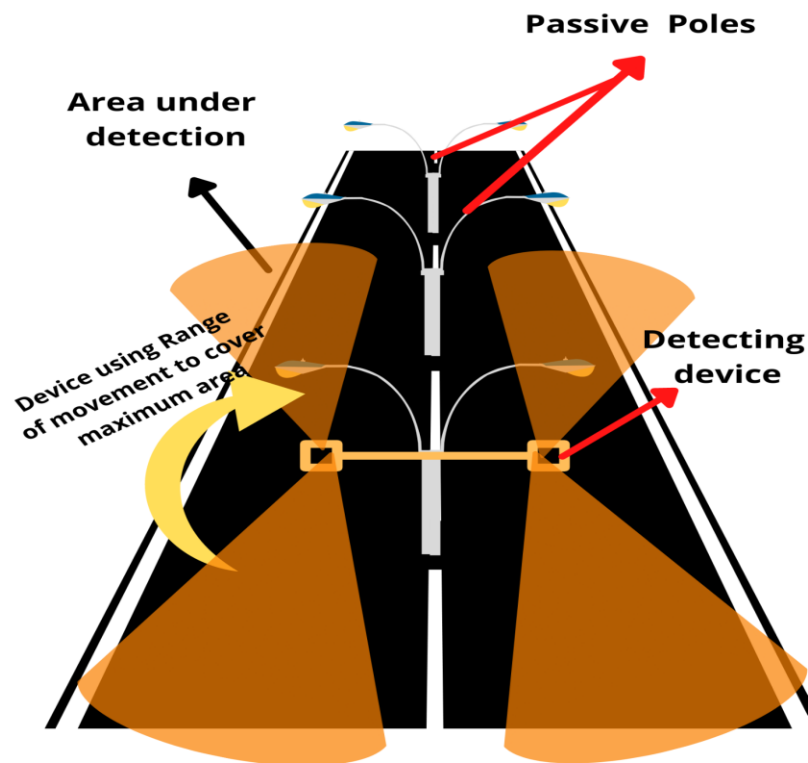


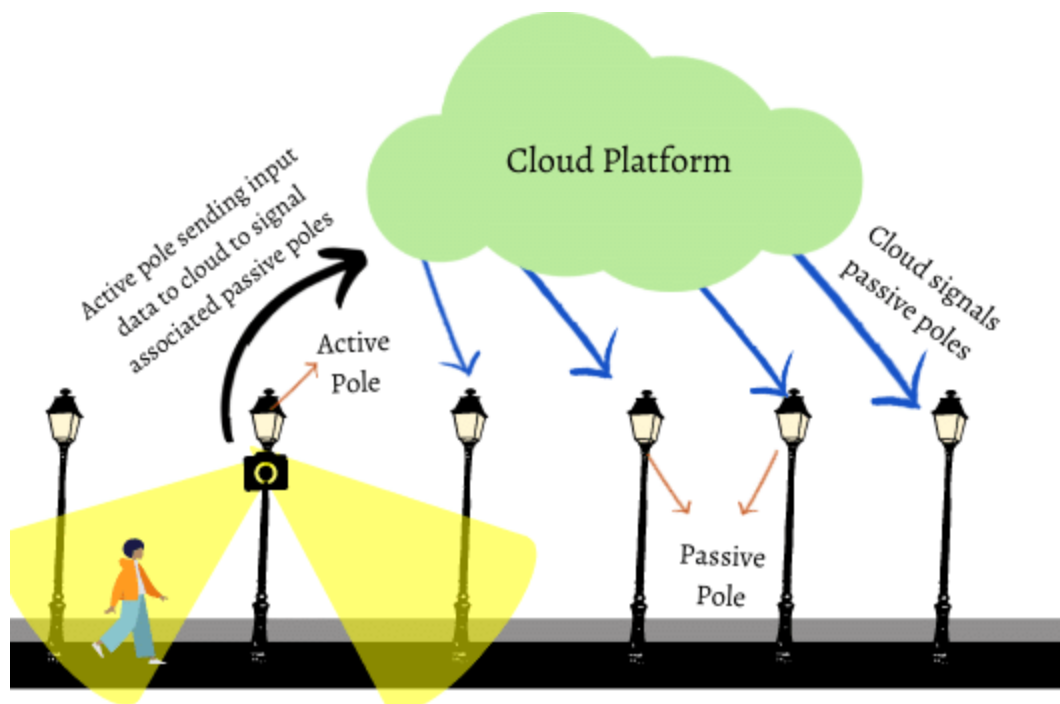
Fig. 2: Representation of placement of sensing device on street lamps

- Designing software of the device

All the units or poles will have a unique Device Identification Number(DIN), which will hold information like name of local area, details of the road or street, position of pole etc. Those poles which have an active characteristic will have a unique Activation Identification Number(AIN) which will hold similar information as device identification number, but apart from that it will have all those DINs listed under it that need to be triggered. There can be more than one list of DIN's to be triggered for the same AIN depending on the direction of detected motion by the device. Another thing is that two or more AINs can have lists of common DINs for triggering .

These devices will be connected to each other and to the receiving units by the means of IoT, and all the data related will be stored in a cloud platform. Cloud platform can be used for storing and extracting data related to triggering of devices. These detecting devices will be represented by their active identification number(AIN) in the cloud, and will report an entry in it with details like AIN, time of triggering, direction of detected motion, human or vehicle, duration of triggering and at last turn off time.

Devices that recently detected motion can also give a wake up signal to the nearby devices to be alert to detect motion from specified direction. If this device didn't detect motion as per the alert it can also give feedback to the earlier device concluding the above human or vehicle had stopped its motion or took another route. Similar other functions can also be added.



Turn Off Signal

The detecting device will send a turn down signal to the associated devices on several cycles of no detection of any motion. DINs that get triggered by an AIN, can get turned down by that AIN only. As different AINs can have common DINs under it, in the case of triggering of a DIN by more than one AIN in a duration of time, the function of turning it down will be performed by AIN that triggered it most recently i.e last triggering AIN will be turning off the respective DIN.

Data Interpretation and application

Data stored this way can be used in a productive way after its proper analysis and interpretation. It can be used for following purposes-

- ***By the State Authority***

- ❖ It can be used by the state for identifying paths taken by any culprit. Like if police are chasing a vehicle being driven by the culprits, the control room can send an alert signal in which direction the culprits are trying to run away. In this way the control room will be given live updates about the culprits as everytime they pass by our device it will detect its motion and notify the authority.
- ❖ It can also be helpful in investigation purposes. Like if a complaint is filed of theft or robbery or anything, again by analyzing the data placed on triggering can be used to locate them.
- ❖ It can also be used for tracking the routes of illegal supplies.

- ***Traffic detection***

- ❖ By analyzing the data it can be found which routes tend to be more busy at a given time so that provision of services such as traffic management, servicing, and security can be ensured.

- ***Reducing unnecessary consumption***

- ❖ If cameras are being used for surveillance be it indoor or outdoor this system will help in avoiding storage of non required data in the memory. Thus only useful data will be stored and will also last longer in the available memory and can be extracted when required.

Conclusion

In this way an effort can be made to answer some of the questions around us related to conservation of resources. We can look up for a solution to the problem of unnecessary use of electricity in the outdoor environment. Electrical systems from generation to distribution already experience a lot of losses, and if we go on wasting electricity around us, the resources with which we produce this energy will vanish and our future generation will have to suffer this loss.

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