An IOT Framework Supporting Ubiquitous Environment

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Abstract: *Ambient intelligence deals with a new world of ubiquitous computing devices, where physical environments interact intelligently and unobtrusively with people. These environments have to be aware of people's needs, customizing requirements and forecasting behaviours. The IoT is one of the most critical aspect of this intelligent environment. Technological growth in different areas has connected most of the everyday equipment, places or situations to the internet. The objective of AmI is to broaden the interaction between human beings and digital information technology through the use of ubiquitous computing devices. The information media becomes possible through new types of interfaces and allow drastically simplified and more intuitive use of devices. The IoT framework thus shares a symbiotic relationship with the sensors embedded in the context aware environment. The whole system is optimised to be used with the existing infrastructure where the information is disseminated through secure channels and to the appropriate set of targeted or intended users. The novelty of the proposed system lies in the uniquely engineered solution for distinct scenarios where the desired AmI is achieved through interactions with the smart devices of the user group. The wireless box model intended for the purpose may be placed strategically to gather user centric data. The device can be used to gather area specific data by placing it in vehicles with fixed pre-defined paths like a metro, or patrol cars. The location detection with appropriate sensors serves to provide extremely reliable and accurate data. Thus, the huge potential of the proposed model to generate open data which serves as the backbone for the intelligent environment implementation and realization of smart cities is remarkable.*

Keywords: Ubiquitous, IoT(Internet of Things), Ambience Intelligence, Open Data

1. Introduction

The internet of things is one of the most promising fields in today's world. The IoT is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

Things," in the IoT sense, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, sensors for environment monitoring.

The expansion of Internet-connected automation into a plethora of new application areas, promotes the IoT to generate large amounts of data from diverse locations, with the consequent necessity for quick aggregation of the data, and an increase in the need to index, store, and process such data more effectively. IoT is one of the platforms of today's Smart City, and Smart Energy Management Systems.Several applications can and have been conceived out of the IoT domain, be it home -automation, smart street lights, automated common cards etc.

Today, most of the people own a smart phone which provides the IOT a link to deliver its services to the last person. Ambience is a specific area where IoT implications can result in very positive changes in ways the issues related to it are dealt. Continuous monitoring, timely evaluation and analysis of the data being collected on a regular basis leads us to determining the general behaviour pattern of a certain area of the wide surrounding.

This concept can be implemented in a wide spectrum of common areas as well as smaller organisation houses.

Factories, streets, walkways, theatre, shopping malls, commercial complexes, business districts, apartments, metros banks etc.

It is seen worldwide that people generally don't know much about the place they are residing, working or are headed to in terms of what kind of ambience the place offers them. This leads to them being unprepared for what they go through in terms of the air quality that they breathe, the amount of exposure to light they get, the temperature that one faces etc.

It is of great importance to provide the common public with the useful information about the environment they are present. Using the concept of open data for all, the scope of this paper is to derive a solution to the problem of unavailability of much information about the area's ambience. Adding to this, the proposed model also has the capability to notify the authorised about any deviations from the usual. The motivation for this paper is the willingness to determine any issue related to the environmental parameters at the very source. This if done properly can reduce the cases of mishaps in a certain city or a region by a considerable percentage.

In section 2, we have discussed the previously available technology related to the IoT framework in ubiquitous environment. Moving to the section 3, we have discussed the model that we propose as our solution to the problem.Under section 4, We have shown how the proposed model can work in real-time environment, the deployment of the model, collecting and storing the data from the ambience. In section 5, We deal with the results that we obtain from the data that is acquired and talk about the alert mechanism. The paper is taken to a conclusion in section 6 with a scope for future enhancements to the work.

2. Background and Related Works

Lots of research has been undertaken in this domain to find out a viable way of developing the solution that we had thought of.

Ubiquitous computing (pervasive computing[11]) is the growing trend towards embedding microprocessors in everyday objects so they can communicate information. Ubiquitous computing relies on the convergence of wireless technologies, advanced electronics and the Internet[9][12]. The goal of researchers working in pervasive computing is to create *smart* products that communicate unobtrusively. The products are connected to the Internet and the data they generate is easily available[15].

Here a example of pervasive computing is explained with the replacement of old meters with new smart meter. In the past, electric meters had to be manually read by a company representative. Smart meters report usage in real-time over the Internet. They will also notify the power company when there is an outage, reset thermostats according to the home owner's directives, send messages to display units in the home and regulate the water heater.

Ambient intelligence appears poised to cause remarkable changes in the way people live[8]. Using ambience intelligence the ease of communication between humans and computers can be greatly increased with the help of digital information available on smart mobile communication devices. Ambience intelligence allows computers and machines to adapt to user environment and give priority to user's preferences. Ambience intelligence not only makes our machines and environment powerful but also making it smart adding increased safety, security, and entertainment[14]. This technology will not only impact our private lives but will have a great impact on business as well as on government activities.

Ambience Intelligence promotes user-centric design where the user is the key and is placed at the centre. He controls the system by giveing feedback through specific user evaluations and tests to improve the design or even co-create the design together with the designer[5]. More and more people make decisions based on the effect their actions will have on their own inner, mental world. This experience-driven way of acting is a change from the past when people were primarily concerned about the use value of products and services, and is the basis for the experience economy. Ambient intelligence addresses this shift in existential view by emphasizing people and user experience.[10]

Cisco Model of Smart + Connected Communities[1] is a great example of ambience monitering.In a typical workplace infrastructure, facilities and technologies that are provided as a matter of course can broadly be divided into two categories: IT systems and applications, and core building systems. Not only do these two groups operate in largely isolated silos but each individual component within the groups is not connected. In other words, all the individual components operate as independent systems without any centralization[2].

The solution to this problem is found using the S+CC approach. It basically allows the end-user operability, retrieval of data related to various points in the campus such as: parking, upcoming meetings, atmospheric conditions etc. They has created a unified platform where all of this data is sorted and displayed according to the suitability of the user who wants to extract any specific information for his own purposes. In case of any deviations from the pre-defined schedule or if there are any new notifications, an alert system is created to inform the required person about the same. Although, this solution is provided within the limits of the organisation but the idea can be extended to a variety of locations.

IoT framework which is is increasingly becoming more popular mainly due to the fact that almost all the smart devices nowadays are network enabled to facilitate many current and emerging applications[4]. However, some important issues still need to be addressed before fully realizing the potential of IoT applications. One of the most important issues is to have effective approaches to planning various device actions to satisfy user requirements efficiently and securely in mobile IoT applications. In order to do this it proposes an interconnected network of the devices which can share the data amongst themselves. Doing this, system tries to solve the problem and providing the user with an utmost clarified information and awareness about the related environment.

The localisation of the IoT device may also play a important part in ambience monitering[3]. The author talks about how the device can be used to get very specific local data which can be related to any of the characteristic of the environment. With billions of such devices if deployed, we can have the opportunity to utilize these devices in converting our physical environment into interactive, smart, and intelligent computing infrastructures. To demonstrate the feasibility of the same, author has ported a lightweight version of MapReduce to run on IoT devices, and evaluated its performance.

3. Proposed Model

The proposed model can be easily described by a simple diagram which has been shown in figure below. Here, as we can see, the sensors are present in the environment within the box that we have created.

Each of these sensor reads a particular aspect of the environment and sends the data to the galileo board which is again attached to the system. The galileo works as the adhesive force behind the entire work model. The sensor data that is obtained is allowed to pass through various stages depending upon the requirements.

If needed, the data from the various sensors can be directly shown onto the computer screen or to a device connected to the model using any internet connection. In other case, the data is allowed to go under actuation, processing and filtering processes. These are done to provide the decision making system with sufficient material to deal with for deciding the threshold values of the parameters.

The upmost values are stored into the galileo so that if there are any changes in the environmental aspect then the same could be easily identified and detected.
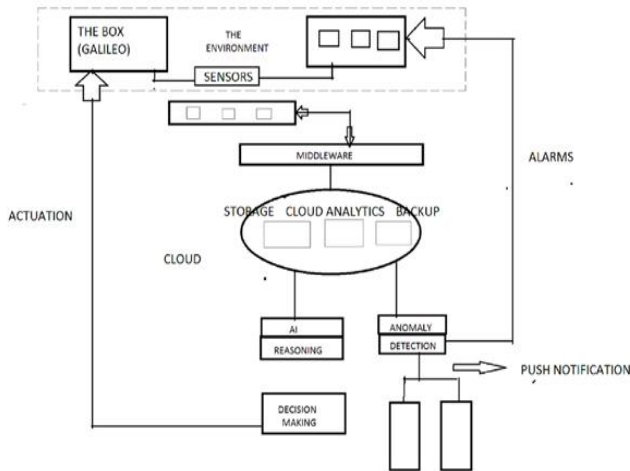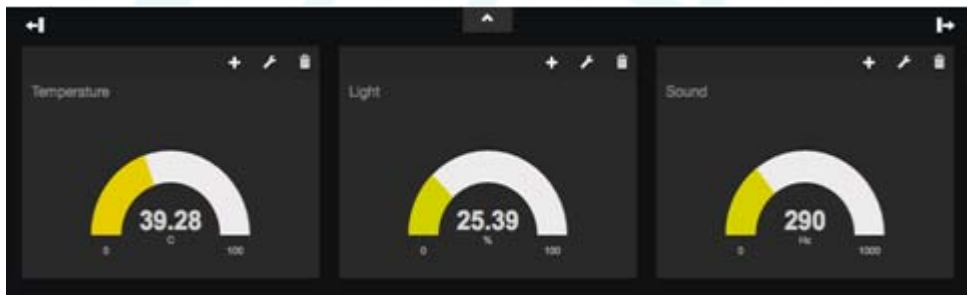

The cloud is used to store the data obtained for a long term, for it to be available to the common public as an open data related to the environment. It is done so that the common citizen in equipped with the data that he needs to find out the area specific information and in case of any anomaly he/she may be able to take up an action before the authorities do.

The above figure is a testimony to what has been said in the previous lines. The user can get to know about the Noise levels, Temperature variances, light sensitivity etc of the location within the campus where the model is placed at. Whenever the user needs to check for the environmental parameters, he can just open the Web server and can get the related information in his smart device easily.

In any environment it is possible to have certain mishaps which calls for immediate response from the people who are
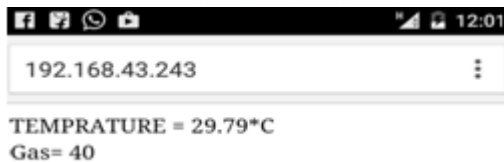
An alert mechanism is attached within the same to provide a warning to the people of the area concerned about the unwanted changes that have occurred. This maybe in form of the buzzer sound or it can be further extended to the smart phones where through push notifications one can be easily informed about the issues.

4. Implementation

The implementation of the Box model is carried out in our college building at many different locations. Consider a user who is a part of the faculty or staff wishes to keep a check on the environmental parameters within the college campus. The user possesses a smart device and wants an immediate response from the box whenever he approaches it. The box contains sensors which are attached to the galileo board. Each of the sensor works with a specific parameter. Each sensor is packed with its own code which allows us to retrieve the data. This data from the ambience is then read and is sent to the cloud for storage. The stored data can be used by the user for a daily 24-hour analysis of his/her environment. Once the user wishes to access the information for the entire day or for a specific time, he accesses the web server where he finds the data being updated and stored for him to analyse the environment.

responsible for the activities within the same, they maybe citizens, staff, employees etc. Here, in the college campus, we may consider the faculty members responsible for controlling the noise levels within a class or on the campus, or the maintenance-staff members being responsible for keeping a control on the overall campus temperature. However, in case of any environmental parameter values exceeding the threshold for a long period of time may result in an unwanted event which needs to be prevented. As the box can detect these unwanted changes in the environment, it will announce the same to the authorised personnel through a notification on to the smart device he possesses. Once being informed the person can take appropriate steps to control the unwanted change.

Event	Datapoint	Value
status	cputemp	76
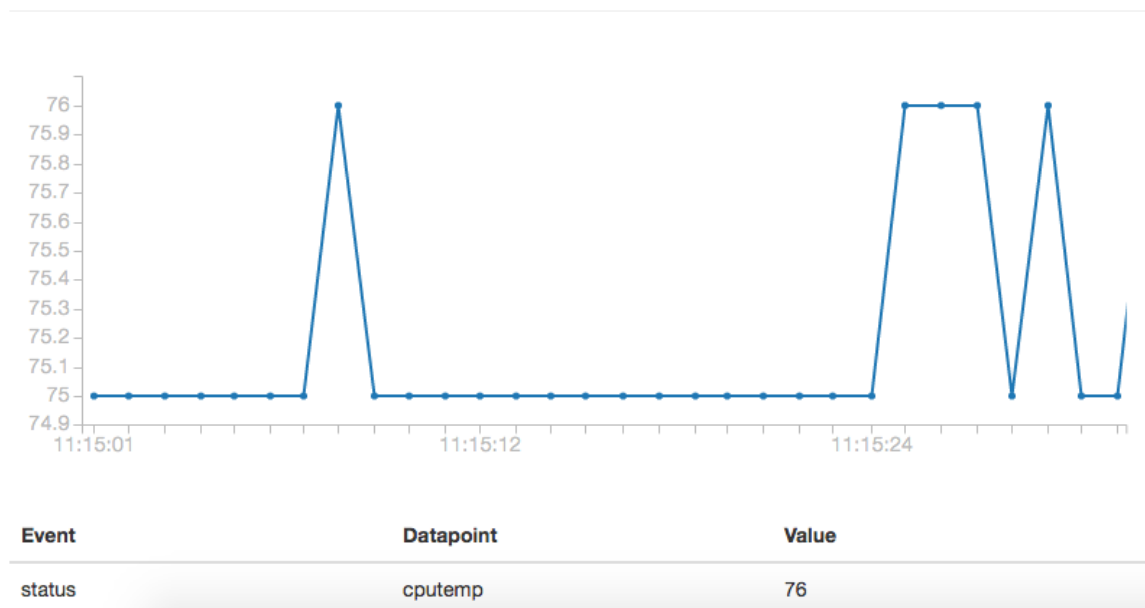
5. Results

Based on the analysis, design and implementation of the proposed system we get a number of results ranging from sensor data values of different atmospheric parameters to the data variation with time. We test the system under various instances and for different conditions to check for any issues in the working model.

The temperature sensor takes the reading of the ambience temperature and displays the same in unit of *C (Degree Celsius).The gas sensor deals with the ppm (parts per million) value of the smoke available in a particular environment.

Once we have taken the value from the sensors, the same can be sent over the smart devices using the internet connection. The below result shows the Temperature in degree Celsius(*C) and gas in parts per million (ppm) being displayed on the web server which is running on a smart phone.

One of the main features of the project is that it allows the timely evaluation and description of the data that is obtained from a particular sensor in a graphical form which can be used to understand at what time the anomaly existed in the environment. The following result is the testimony to the above said.

Based on the above, we have an alert mechanism attached with the same which allows us to send the notifications to the respective people regarding any anomaly that is detected by the system

6. Conclusion

There are a number of systems available for getting the data from a variety of aspects of the ambience. But the concept of having it open to all is what that makes our effort different from the pre-existing ideas. Using the system not only one can get to know about its ambience he may also be able to control or put an end to any anomaly very close to the source. Hence, this system is very effective for ambience intelligence.

This system apart from disseminating the information also allows to give alerts to the people related to a specific area so that they may get to deal with it better.

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