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Multiple Architectural Approach for Urban Development Using Wearable IoT Devices: A Combined Machine Learning Approach

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Abstract

Machine Learning becomes a part of our life in recent days and everything we do in interlinked with machine learning. As a technocrat, we tried to implement machine learning with Internet of Things (IoT) for better implementation of technology in organizations for security. We designed an sample architecture which will carry the burden of safeguarding the organizational data with IoT using machine learning with an effective manner and in this case we were proposing utilization of cloud computing for better understanding of data storage and retrieval process. Machine learning is used for the prediction models based on which we need to perform high level analysis of data and using IoT we promote authorization mechanism based on which we recognize the appropriate recipient of data and cloud for managing the data services with the three-tier architecture. We present the architecture we are proposing for better utilization of machine learning and IoT with cloud architecture.

Keywords

Cloud Computing, Machine Learning, IoT, Authentication, Architecture

1. Introduction

Machine learning in real-time scenario plays a crucial role and we need to concentrate on how to improve the technical architecture for the security systems with high level data transmission and protection, how the data is transferred from one device or sensor to the repository and how the data is managed and how to get and update the information. Here we are proposing a four-tier architecture which will create a revolutionary implementation in science and tech-

nology related to ML and AI. In [1], authors discussed about the concept of implementation of IoT and cloud in urban development which leads to utilization of different mechanisms in machine learning. The goals the authors discussed in this article are regarding identifying the low cost implementation, effective data collection, robust methodology, globally acceptable thing. These are the main focus things of authors mentioned in that article. Wearable devices tackle the information with from sensors of the devices and transmit them to the server or the repository in cloud. For providing services for the wearable devices, we need to have large setup and we need permission from the cellular network provider [2], or we need to gather or create the custom applications which are written in mobile platforms support [3]. We need to consider the security measure that how we can utilize the personal data without causing any security bleach [4]. In this architecture, we have four stages and in the first stage, we have a sensor which will trap the all the data from the surrounding environment, in the second stage, we have a middleware like a data converter which will convert the data captured by the sensor into human readable language which will be having the combination of IoT and ML. In this phase we need to translate the things using ML algorithms like NLP [5]-[10]. Natural Language Processing is a mechanism using which we will convert the unstructured data to semi structured or structured data. Third face will have the cloud repository using which we need to store and manage the data and we don't have much pressure in working on it. Instead of establishing repository we can leverage resources from the third party services like AWS, GCP etc., in the fourth phase we have to gather all the data and process it and find the result we want [11]-[16].

Our intension here is very clear and we are trying to design and implement generic architecture which will fit for IoT and ML devices for better prediction. In the later sections, we discuss about the domain of implementation, what are the challenges is highlighted in that domain, in next section, we discuss about the individual tiers of implementation, later section deals with the architecture explanation, final section is with expected results and conclusion.

2. Domain of Implementation

2.1. Urban Development

In this urban development we need to consider the defects around you to understand what the people need and there are any security measures we need to consider to explain to the higher officials. In this urban development as the survey conducted by open sources these are the challenges they are facing.

- Lake of proper security for women;
- Road damage;
- Improper constructions;
- Water problem;
- Education system;
- Traffic issue;

- Medical problems;
- Electricity;
- Food;
- Human Mafia.

In all these things consider the issues what can be identified by the sensors of the wearable devices. The issues like security, road damage, traffic, electricity and human mafia. Let's discuss everything in details as below.

2.1.1. Security

People while traveling or walking on roads they need to wear a device which is connected to mobile with a pre installed app through Bluetooth and mobile has to be connected to the repository through mobile data. Some people may think about the battery draining of the device because it have to be connected to server, but the thing here is this is a mandatory thing in our architecture [17] [18] [19] [20] [21]. Using the wearable device we can take images on the road and they will be transferred to the mobile and those will not be shared in the device and will directly transferred to the central server in the cloud repository of the agency. There based on the requirement we need to process those images and clips. Our intelligent machine has to identify what's happening in that image. This will happen only with machine learning and AI [22] [23] [24].

2.1.2. Road Damage

Images from device related to road will be captured and sent to central server, then based on the image, we satellite over view will come to the machine and identify where that road is located and based on that information, specific department will be alerted for recovery of the road and solve it as soon as possible [25].

2.1.3. Traffic

Traffic system will be maintained by taking images of current location and update into the central traffic system server. It will update to all the people in the surrounding locality to avoid the traffic disturbances [26] [27].

2.1.4. Electricity

Electricity issues are more in the rural areas as well as interiors in the urban areas and people may not able to communicate to the officials about their issue [25] [28] [29] [30]. In this way using the wearable device we are proposing you can transfer the information in the form of chain link from one device to another device t o intimate the issue to the respective department. Regarding the architecture we will discuss in the lateral sections clearly.

In the above detailed analysis we have different challenges in urban area development using IoT wearable devices which will transmit the data. Here we are only proposing the architecture and not prescribing any networking scenario to transfer the data. And this can be considered as the future extension of this current scenario we are following [31].

Using this proposed architecture we are overcoming the existing system issues like efficient utilization of technology and we are proposing advanced framework of the data sharing and problem solving mechanism. In the next section we are going to discuss about the current scenarios in market and finally we will explain the proposed architecture.

3. Existing Architecture

The following architecture is the present existing architecture and we are using SENSg technology proposed in the existing architecture to transfer the data from wearable devices to the repository. The following image will explain the concept of existing architecture using SENSg [1] as shown in **Figure 1**.

The present approach consisting of the SENSg technology which was proposed by [1] and this will lead to take utilization of cloud and API's [5] [6] for better implementation of data transfer in a better way. The current scenario will connect the device with internet and using the API's data is transferred to cloud and they are maintained for further implementations. But the thing here is we need to utilize temperature pressure control devices for effective maintenance of the device and architecture [32].

Figure 2 will define the IoT device architecture which is as follows.

Here the existing work authors use two types of PCB's. One is single sided v4 PCB and other is double sided v3 PCB as shown in **Figure 3**.

4. Proposed Architecture

In this proposed architecture we are focusing on implementing ML with IoT with four tier architecture. In this architecture we are having four different regions and they are explained here below.

4.1. Wearable IoT Device

A wearable IoT device like **Figure 4** mentioned below will have the inbuilt camera and the controller fixed to it. Using controller, person will take pictures of the issues around him and upload that to the server through tier 2. It's an IoT network Controller.

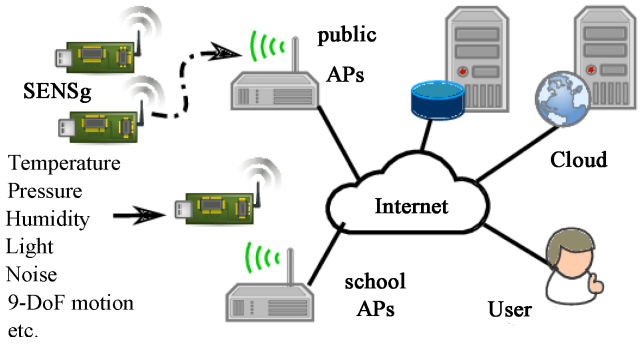

Figure 1. SENSg Architecture.

Figure 2. IoT device in use.

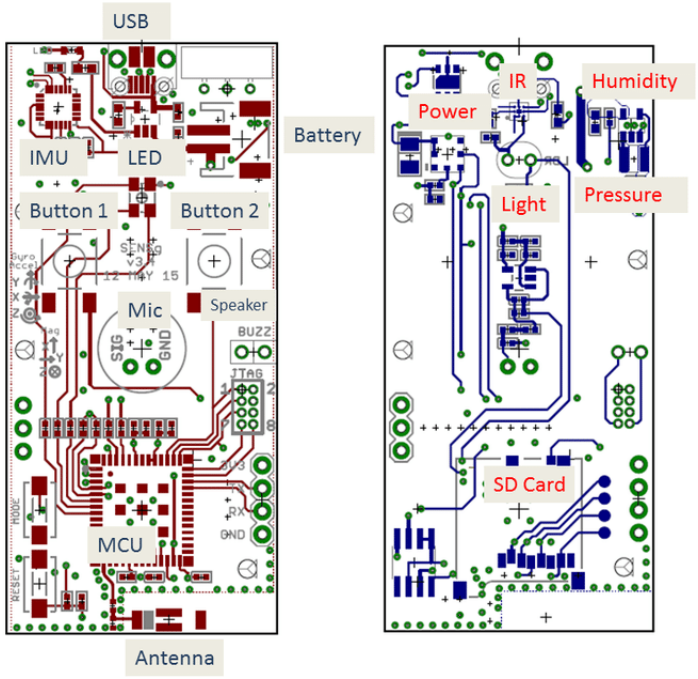

Figure 3. Double Sided PCB for V3 board.

Figure 4. IoT device which have capability of taking images (Proposing Design).

This wearable device will capture the image by clicking and we can't see the clicked images and they will automatically move to device in which app is being controled. This is tier 2 and it is resembled in this paper as IoT networks [2] [3] [4] [5].

4.2. IoT Network (Application Layer)

In this tier we are discussing about the how the data is transferred to the device in which application is installed how we are not storing information in device even not as temporary data. Here using the IoT networks the data transferred from device to the cloud. In this stage we are proving security measures to maintain high security of the information which is in the transmission. The main cause of separating networking pattern is here we are considering application in the mobile device and the reason behind not storing information in device is to maintain security. This information from IoT device has to transfer directly to the server but it has to be through a medium. That's the reason why we are using application in mobile and transmitting information through application [6] [7] [8].

Figure 5 will resemble the network point of the IoT device and this will be considered as the tier 2 of the architecture.

4.3. Cloud Storage (Database Layer)

The database layer consists of the information we transferred from the application to the cloud storage in the remote location. We have the sample network in cloud storage and we have to take network access from CSP (Cloud Service Provider) to manage the access.

4.4. Machine Learning (Predictions Phase)

Machine Learning is for designing prediction models through various algorithms available. To convert image or video to text we need to use NLP and based on the information gathered we need to transfer the specific issue to the respective department [15].

Here is the sample architecture of NLP in machine learning as shown in Figure 6.

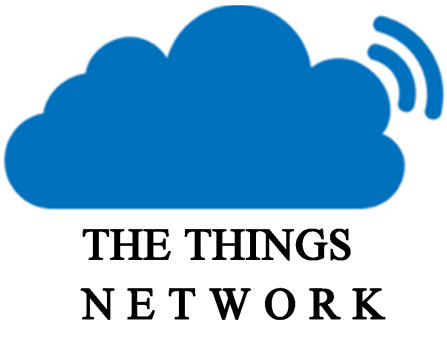

Figure 5. Enchrypted IoT network through application.

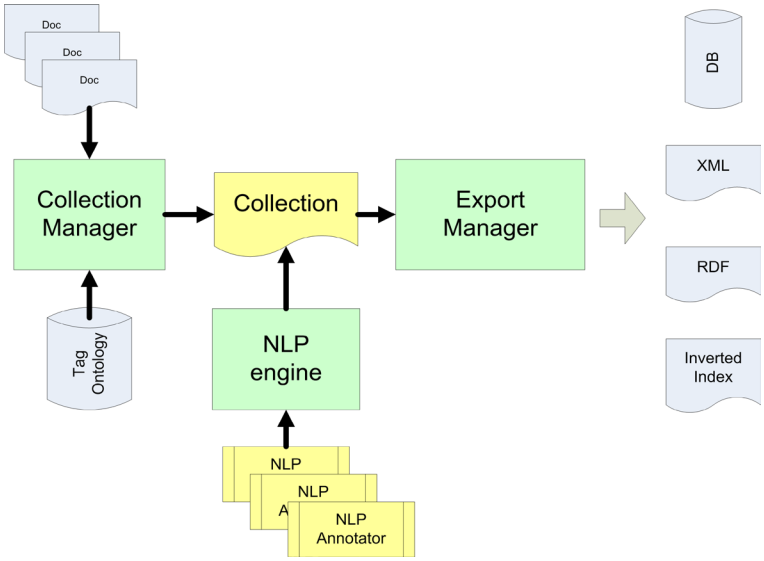

Figure 6. NLP Architecture.

By considering all the above tiers we are prescribing one architecture which will solve the problems in urban development using wearable devices in ML and IoT combination with the support of Cloud Computing as shown in Figure 7.

5. Implementation and Results

- We can take high pixel images with this device with the help of camera in-built it.
- High secured data transmission and data is transferred through encrypted file and we can do that encryption using RSA algorithm.
- High level predictions will happen with NLP converted data. We can predict the high chances of issues based on locality.
- High accuracy in predictions.
- High utilization of Cloud architecture and services.

5.1. Implementation Procedure

Implementing this kind of architecture is typical task and we are succeeded in this and we are up to some valuable extent and the details are as follows.

5.1.1. IoT Device Architecture

IoT device architecture will be different from other devices. I will consist of a camera sensor and which can take images with a click on the controller. We have to control that device with Bluetooth connection to the mobile device in which the device application is running in background. Here we use Bluetooth protocol BLE (Bluetooth Low Energy). This protocol is from Bluetooth V4 and this uses low energy from the devices and this will be using for this architecture and this will used by the wearable device and the data is transferred through that protocol. For example consider a hospital management through wearable device. Patient information will be transferred to the server and then to doctors premises.

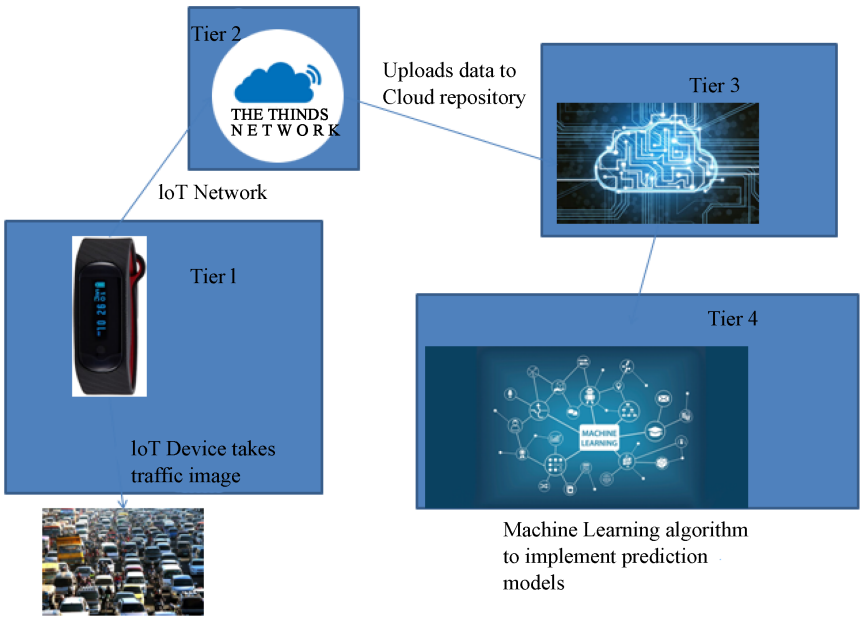

Figure 7. Prescribed urban development architecture.

BLE protocol is based on GATT which means Generic Attribute. This defines how the two devices will connect to the low energy bandwidth. Like standard Bluetooth architecture we need concepts like services and characteristics.

5.1.2. Cloud Operations

The concept we are using for cloud architecture is AWS. AWS will work on various platforms of implementations at a time and its IAAS will support all the networking concepts and it will provide the high bandwidth and low fault tolerance architecture of the network. We can scale up and scale down.

5.1.3. Natural Language Processing

The concept of machine learning will be satisfied with using NLP to perform some prediction operations and whenever any video was recorded we can transfer that from video to text so that we can understand what's happening there. And we can forward that text information to the respective department.

5.1.4. Results

The results we got met our expectations and these are as follows. In this graph we have number of cases registered and what is the frequency of getting the same kind of issues as shown in Figure 8.

Figure 9 chart explains the monthly report we gathered.

6. Conclusion

The concept of generic architecture will create a mess in some of the technical things. And here we are proposing a generic architecture by taking risk but we try to achieve some things in this architecture with four-tier architecture and we are implementing both machine learning and internet of things with help of

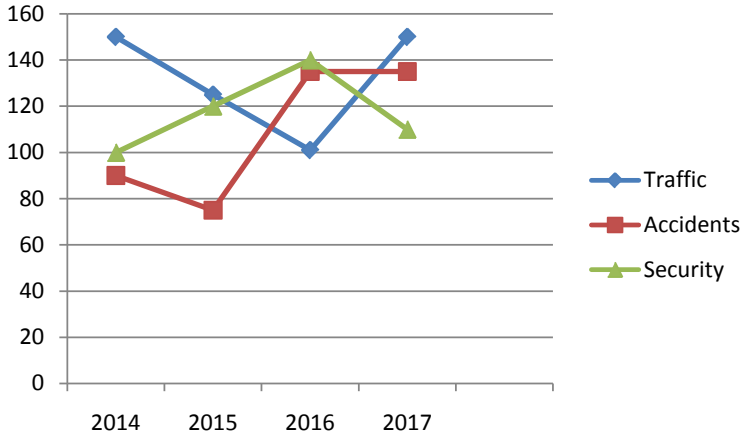

Figure 8. Results obtained by number of cases recorded from wearable device. Yearly Report.

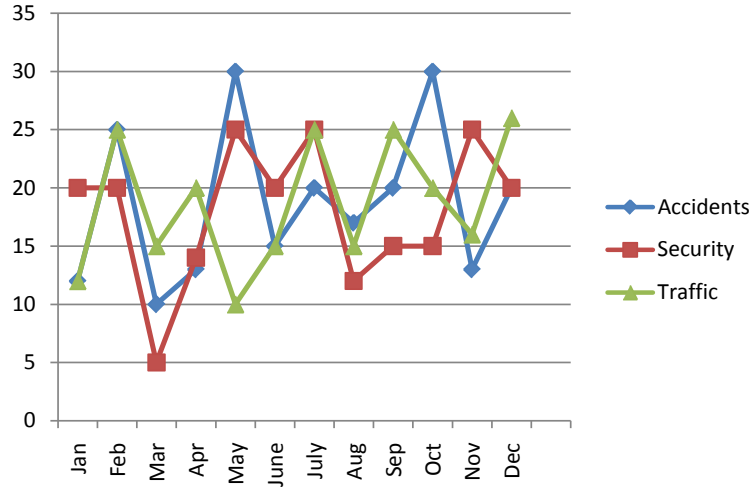

Figure 9. Results obtained by number of cases recorded from wearable device. Monthly Report.

cloud computing for data storage and access. Our architecture will help to protect the data and also will try to share environmental issues and urban area issues effectively. There is no privacy issue in this architecture because if anyone takes any wrong images, they are not even stored in the physical devices and they will be caught if they do any mischief things.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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