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RESEARCH ARTICLE

i-IoT (Intelligent Internet of Things)

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Abstract:

i-IOT is realized by collaborating Cloud, IOT & Naive Bayes to construct a system that has the potential to bestow intelligence to the things in the IoT enabling them to diagnose any glitch in their operational status & upon detection of the same giving them the capability to resolve it without human intervention

Keywords- Internet of Things (IoT), Cloud Computing, Data Mining, Smart Sensors, Naïve Bayes Algorithm

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I. INTRODUCTION

An exemplary instance projecting extensive merging of Physical World with the Digital World is the Internet of Things (IoT). IoT is simply a manifestation of an augmented world which aims at achieving ubiquitous computing. As stated in the Black Swan Seminar Series on IOT, Internet of Things perceives the notion of "Connect Anywhere, Anytime with Anything" [1]. The term Internet of Things came into existence as a vision and was originally coined in 1999 by Kevin Ashton. IoT which was just an inconceivable vision then, today is one of the in vogue technological trend and rigorous work on its effective implementation is in progress.

Implementation of IoT has paved way for smart cities, smart environment, smart water system etc and has profound applications in logistics, retail, security & emergencies.

One such application is the IOT based Smart parking System implemented in the city of Santander which is divided into 22 zones each having its own network parameter resulting in independent sensor networks operating on different frequency channels. Around 375 Waspmotes (which connects any sensor using any wireless technology to any cloud platform) equipped with magnetic field sensors are deployed in different locations which detects the variation of the magnetic field generated by car parked on it. This information is send periodically to the meshlium (connects sensor network to cloud) and is displayed on panels every after 5 min to help citizens to find free parking space.

However, failure of any one of the component of this system will degrade its performance as it will no longer deliver the service consistent with its specification and would require human intervention to rectify it.

This paper establishes a proposition to collaborate the Cloud and the Internet of Things along with the utilization of the efficacious Naïve Bayes [5] [6] data mining algorithm to construct a powerful system which has the potential to bestow intelligence to the things in the IoT thereby making them more rational enabling them to diagnose any glitch in their operational status and upon detection of the same giving them the capability to resolve it by making the devices completely self-reliant. Thus we went a step ahead by imparting 'intelligence' to the things which can encompass almost any object ranging from day to day used appliances like coffee machine, lights, air conditioners to fuel tank in our vehicles to conveyer belts in factories etc. The paper also aims at conquering the limitations of IoT in terms of scalability, storage and computational ability by incorporating cloud which allots on demand access to configurable pool of services (clusters, network, servers etc.)

Eventually it presents a prototypical i-IoT model which is a cloud based system wherein the smart sensors embedded on the devices continuously monitors their operational status and on detecting any fault, glitch or failure in the device functioning it will immediately cause our application to find an appropriate solution by applying Naïve Bayes data mining algorithm on the database inclusive of similar instances of malfunctioning and thereby resolving the issue without any human intervention.

II. MATERIAL AND METHODOLOGY

a. System Interconnection and Hardware:-

1. **Sensors Details:** The hardware used to sense the optical or electrical status of various devices is nothing but the sensors.[7][8][9]

2. **ADC:** As we know now that sensors produce their status in form of optical or electrical signals. In order to convert these signals into useful information, the use of ADC (Analog to Digital Converter) can work for us. In fig 1, sensors are connected to the ADC0808.

3. **Microcontroller AT89C51:** It's a low-power; high performance CMOS 8-bit microcontroller having 4K of flash programmable and erasable read only memory.[10] Combination of a versatile 8-bit CPU with Flash on a monolithic chip makes ATMEL AT89C51 a powerful microcontroller which provides highly-flexible and cost-effective solution for this project.

4. **MAX-232:** Data in the form of TTL/CMOS logic will not be directly consumed by the PC, it needs to be converted in compatible form. The MAX232 IC can be used to convert these logic levels to RS232 logic levels on which the serial communication for PC works on. MAX232 IC will act like an intermediate link between PC and the microcontroller as shown in Figure 1

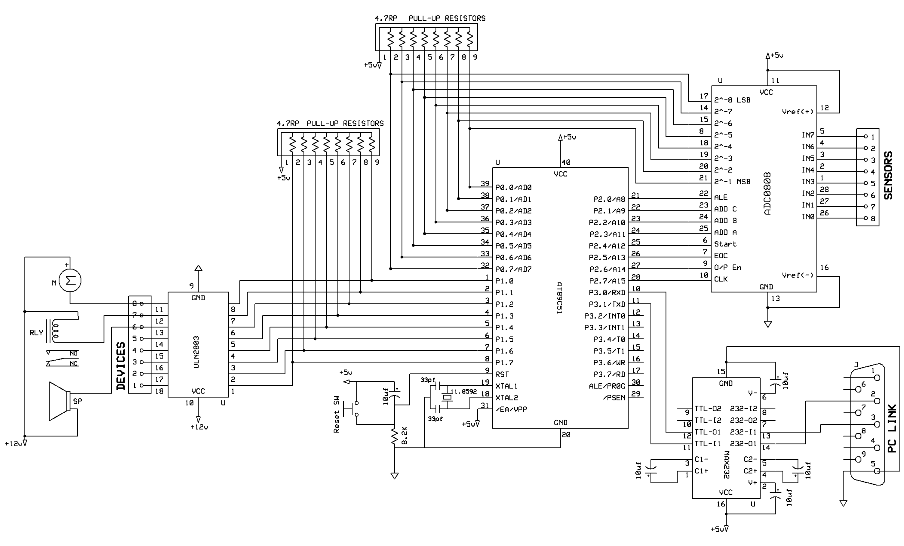

Figure 1: Proposed Circuit Diagram

b. Components of Project:-

1. **The IoT Circuit**

The IoT circuit is a combination of microcontrollers, converters, etc. which takes input from the sensors.[11] The main function of IoT circuit is to take the threshold value from the sensors and transmit it to the home server in a digital form.[12]

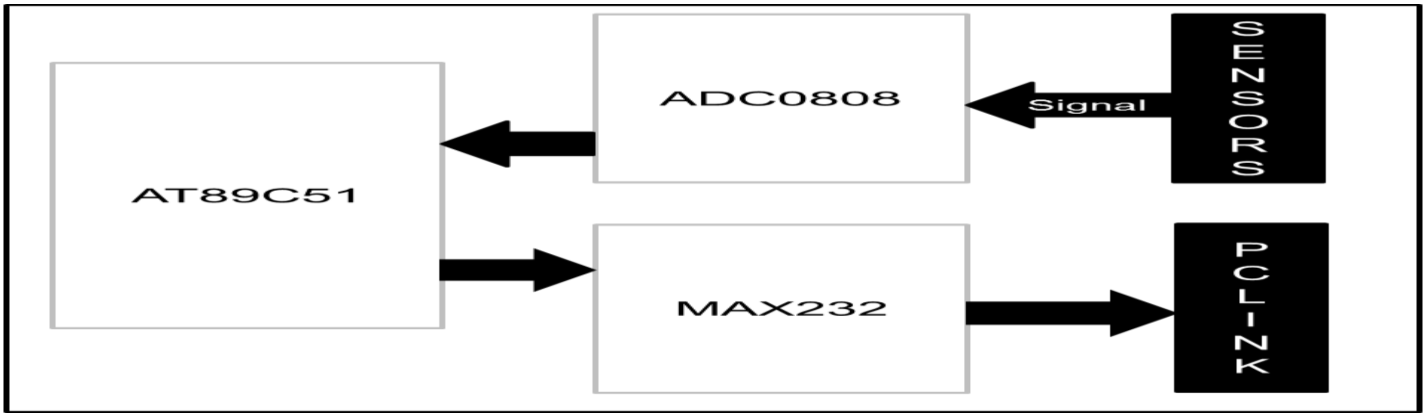

Fig. 2 IoT (Internet of Things) Circuit

2. **Home Server**

Home server is a system that will be installed in home. Home server accepts the input from the IoT circuit and updates it in the form of data on the cloud server. It is also responsible for conveying the message to the particular person in charge as per specified by the cloud server[14]. Home server can also be used for surveillance by just connection a web cam to it to monitor your premises to ensure security.

3. **Cloud Server**

The cloud server is the most important aspect of this project. It takes the data from the home server as input and then further processes it. The cloud server consists of a database that preserves the remedies to the problems detected during continuous inspection of the information send by the sensors. If any sensor reports a problem then, the cloud server performs data mining and picks out a particular solution that is fit to successfully decipher the complication.

This is where the Naïve Bayes Algorithm comes into picture which plays an extremely vital role as it is this algorithm which is solely responsible for imparting intelligence to the devices and making them self-sufficient

For instance, during continuous monitoring of the light sensors, presume that some malfunctioning is diagnosed. When this malfunctioning is further corresponded to the home server it automatically applies the efficient probabilistic Naïve Bayes classifier algorithm to discover the most appropriate remedy. Just suppose the most effective solution in our case would be an electrician with the following attributes:

- Time slot : 6pm onwards availability
- Rating : ***
- Experience : 2yrs(min)

To accomplish this task the Bayes Theorem based Naïve Bayes Classifier evaluates the probability of each attribute in the training set in agreement with the required attributes and eventually the one having the maximum probability that is the one exhibiting utmost coherence is opted as the required predicted result.

Therefore, in this manner the cloud server explores for the best option in the records using data mining and retrieves the most apt remedy without any human intervention.

c. Flow Control

1. All the household devices are connected to the network using sensors.
2. These sensors keep on sending threshold values to the circuit i.e. ADC (Analog to Digital Converter) circuit.
3. The ADC, then converts these threshold values to TTL (Transistor Transistor Logic) compatible signals and sends it to the microcontroller.
4. The microcontroller then sends these signals to MAX232
5. MAX232 converts the TTL compatible signals to system compatible i.e. Digital Signals signal and sends it to the home server.
6. Home server consists of device settings that are defined by the user. If the threshold values received from the sensors exceeds or deceeds the predefined value, then the home server considers this as a fault and reports it to the cloud server.
7. The cloud server determines the fault based on the data received.
8. Then the cloud server performs data mining to select a particular person to do the job amongst the list of several vendors.
9. The cloud server picks the particular person in charge and sends the detail to home server.
10. The home server then receives the contact information from the cloud server and conveys the message to the person responsible.

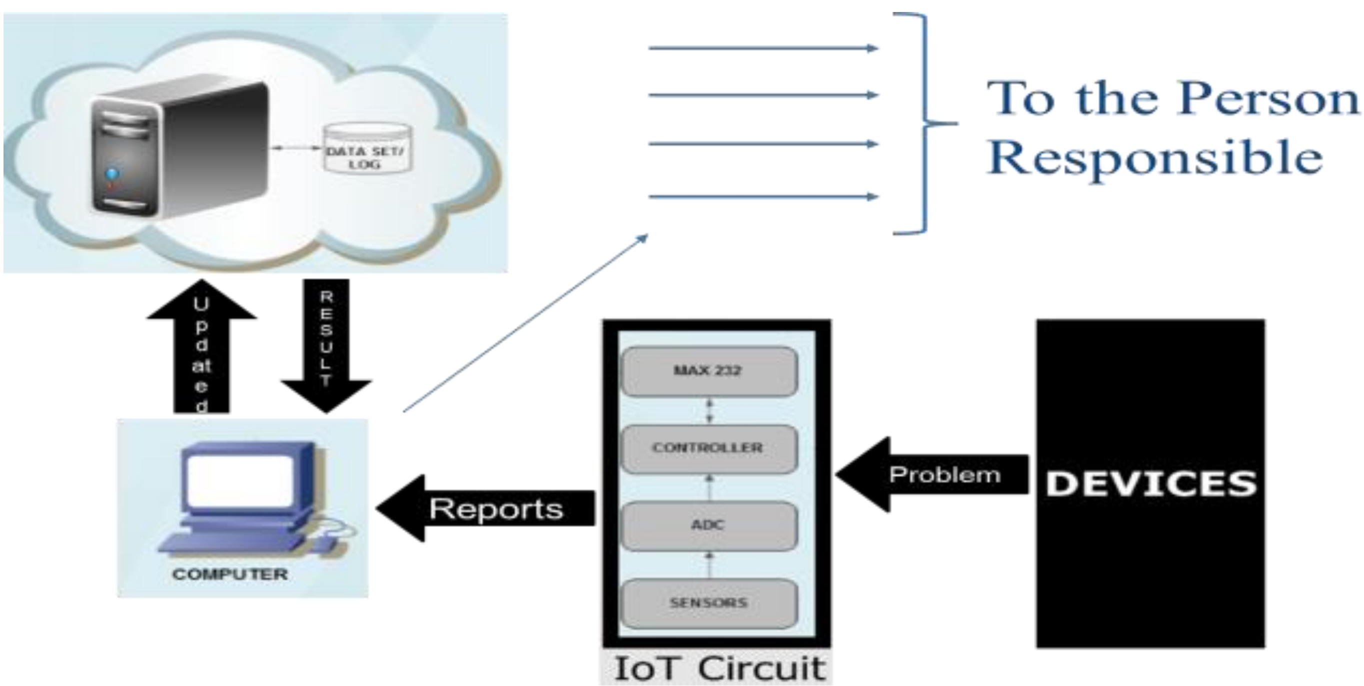

Fig. 3 Proposed Methodology (Flow Control)

III. RESULTS

These are the screenshots of project result while execution

1. Screenshot 1:

   This screenshot depicts the status of the sensors initially. All the devices that are connected to the circuit are turned on. Then after a particular amount of wait time these devices start working that is the sense the environment and submit the threshold value respectively.

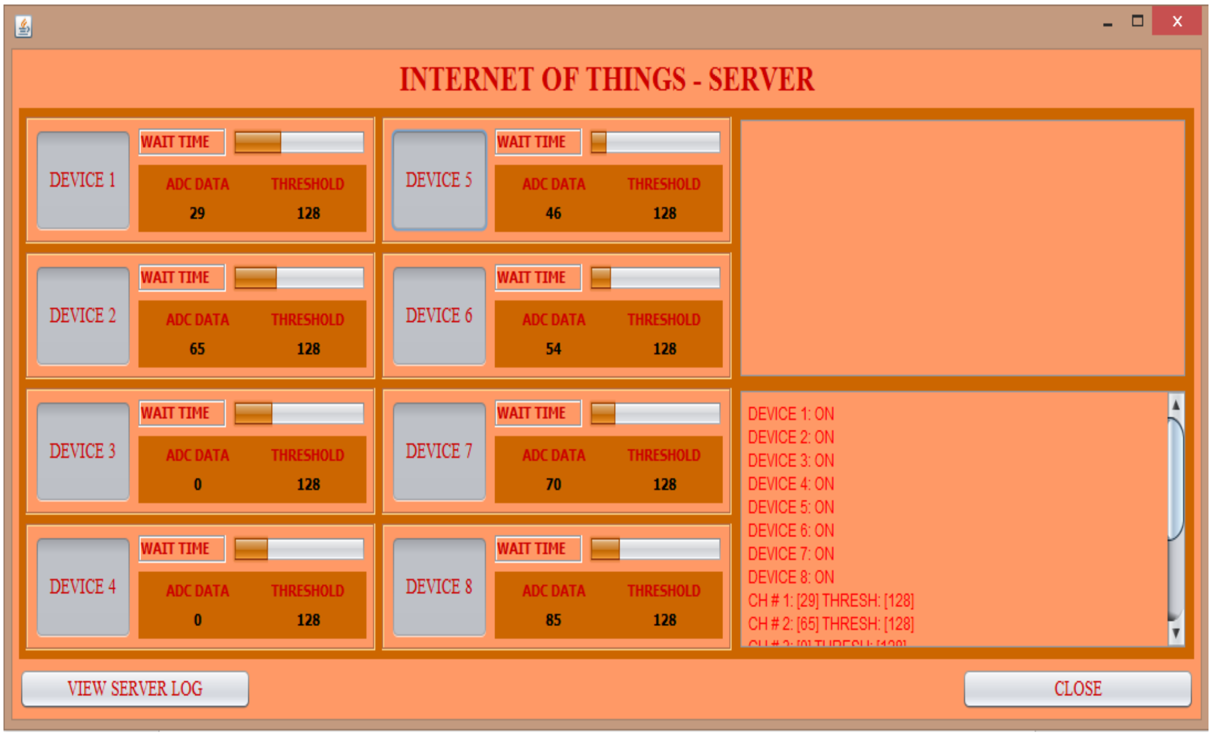

Fig. 4 Initialization of Server

2. Screenshot 2

   This screenshot shows the threshold value that is received from the sensors. These values vary from 0 to 255. User may use his own value of threshold in order to take necessary actions.

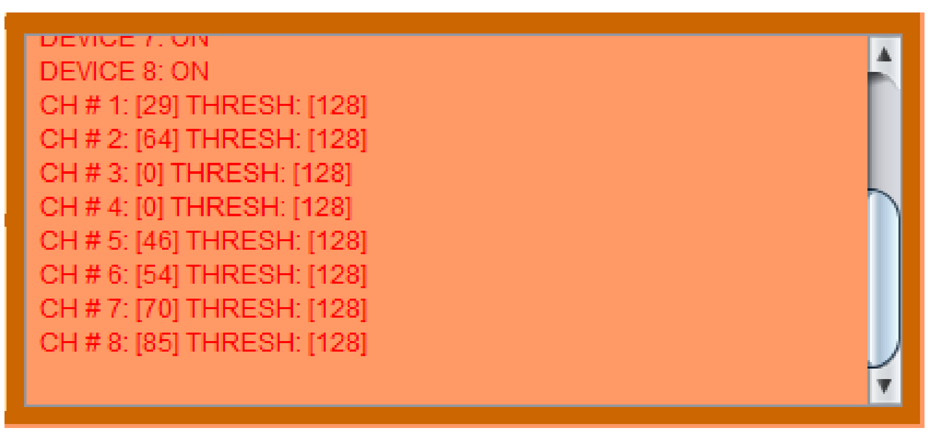

Fig. 5 Threshold Values Sent from Sensors

3. Screenshot 3:

This screenshot resemble the working of project. The sensors, after a particular wait time shows threshold values that are received from sensors. Then according to the sensor settings alerts are generated. These alerts can be seen in the upper right corner of the screen. This window shows which sensor has generate an alert and what is the threshold value crossed

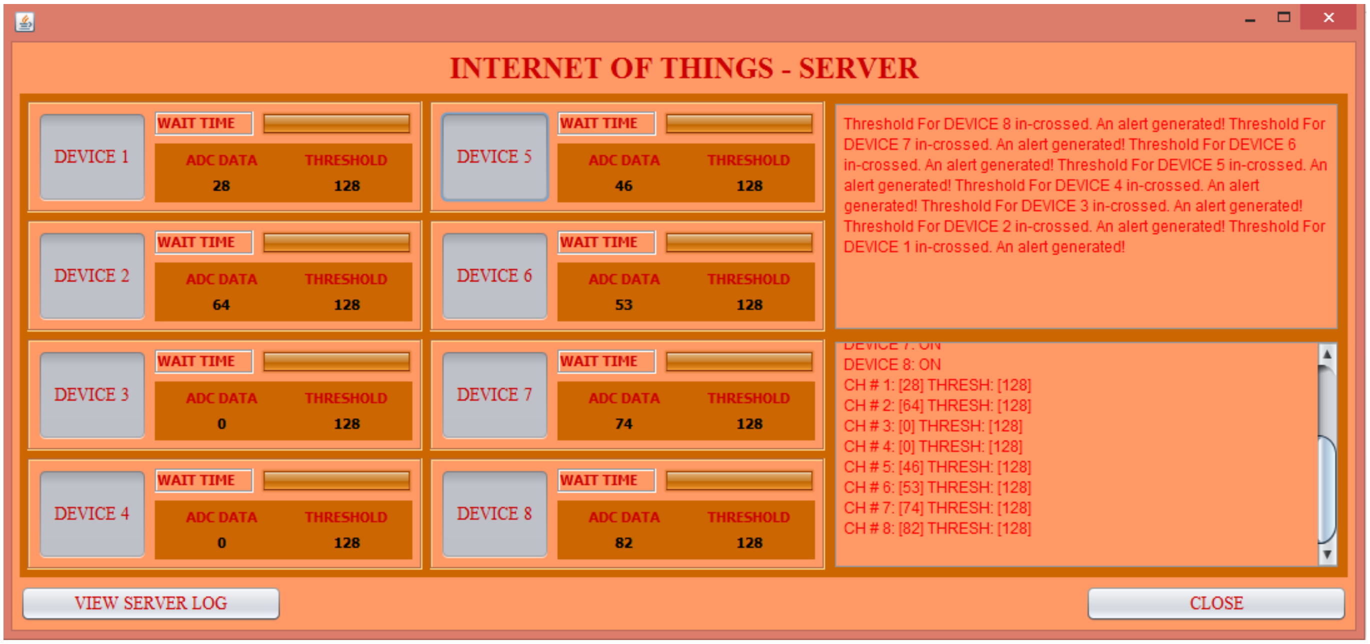

Fig. 6 Project Deployed

4. Screenshot 4:

This screenshot is the image of the server log which maintains a record. This record includes details about the alert generated and messages and emails that are generated and sent to the various vendors involved

Fig.7 Fault occurrences and actions Taken

IV. CONCLUSION

This paper illustrates the implementation of Internet of Things used for monitoring regular used devices. The description about the integrated network architecture and the interconnecting mechanisms for reliable measurement of parameters by smart sensors and transmission of data via internet is presented. The framework of the monitoring system is based on combination of pervasive distributed sensing units, information system for data gathering, reasoning and context awareness. This paper encouraged to develop a system which not only focuses on the automation aspect but also on imparting intelligence to the things in IOT.

This paper entitled 'i-IOT' which signifies Intelligent Internet of Things is aimed at providing intellectual capacity to the objects in the IOT based on cloud to enable them detect any malfunctioning in its working and rectify it without any human intervention thereby making these objects completely self-reliant.

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