# ARTIFICIALLY INTELLIGENT HOME

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## Abstract

*Being able to control aspects of our houses, and for having the feature to respond automatically to events, it is becoming more and more popular and necessary due to security and cost purposes. We propose to implement an integrated home automation and security system. Our project proposes a low cost solution using off the shelf components to reduce cost and open source software to get around licensing requirements of software. Zeus controls sensors and actuators that monitor a defined location and take action based on specified parameters like ambient light, temperature etc. The Zeus can also send alerts if it detects an abnormality. The voice recognition schema allows the user to use voice commands to control his house. Zeus refers to combined hardware of Personal Computer with Raspberry Pi and Arduino.*

**Index Terms: -** *Internet of Things (IoT), Artificial Intelligence, Wireless Sensor Network.*

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## 1. INTRODUCTION

AUTMATION is a technique, method, or system of operating or controlling a process by electronic devices with reducing human involvement to a minimum. The fundamental of building an automation system for an office or home is increasing day-by-day with numerous benefits. Industrialist and researchers are working to build efficient and affordability automatic systems to monitor and control different machines like lights, fans, AC based on the requirement. Automation makes not only an efficient but also an economical use of the electricity and water and reduces much of the wastage. IoT grant to people and things to be connected Any-time, anyplace, with anyone, ideally using any network and any service. Automation is another important application of IoT technologies. It is the monitoring of the energy consumption and the Controlling the environment in buildings, schools, offices and museums by using different types of sensors and actuators that control lights, temperature, and humidity.

The system consists of wireless sensor network which reduces the need of wired sensor and therefore no external wiring has to be done in the walls. Some researches focus on the reducing the risks of the security. The intelligent home system will be convenient to monitor the electric devices or the safety of the elderly or infants in the family. The intelligent implementation can avoid accidents and other hazards to occur.

### 1.1 SERVICES PROVIDED BY SYSTEM

As automation provides wide range of services but four main point for home automation is

- Automatic and Manual Mode Operation
- Remote control
- Uses every appliances efficiently
- Security of the system and of the home

Automatic and manual mode operation refers to control of the system as System needs to be controlled by some user either it is human or the computer. The auto mode should be activated when the user is not present thus giving the control to computer can resume the control state. As soon as user enters the home system should be given in hands of user or should ask for giving the control. As user is a human and he/she may be tired because of the work they are doing so the decision making capabilities of user may reduce to prevent from this situation machine should ask for control giving. Remote Controlling of the system is must as system does have feedback so it should ask user to permit the triggering of an important event like turning on of the heater or any dangerous appliances. System consist of an App which will be connected to system via server. At the server side a client will be listening to set of commands and after successful command sending it should update the database. As system is not directly sending the command to system it is updating the database and at the system side a controller is fetching the state from the database. This enables the retaining of the state if the power failure

occurs or any disturbance is caused. It also helps in performing analysing of the units consumed by the home. Use of every appliance is necessary as if the system doesn't target every single appliance then it won't be called as automation as user needs to operate that individual appliance manually. Security of the commands transmitting receiving and security of database should be considered as any type of interference and create a trouble and can cause and unwanted hazardous activity. And for home security system should consist of cameras which will acts as an eye for the system and based upon visual input system should take actions defined by the user.

### 1.1.1 ARTIFICIAL INTELLIGENCE AND SELF LEARNING SYSTEM

The theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.

In this paper [11], the central controller unit has an in-built algorithm based on two level adaptive branch prediction techniques to detect the period of inactivity of sensor nodes. Further, only one wearable heart rate sensor node is included in the system which measures the heart rate and detects abnormality. The paper [12] presents a color sensor system that can process light reflected from a surface and produce a digital output representing the color of the surface. The end-user interface circuit requires only a 3-bit pseudo flash analog-to-digital converter (ADC) in place of the conventional/typical design comprising ADC, digital signal processor and memory. In the paper [13], based-on the algorithms research, a ubiquitous personal health monitoring and system is designed, which integrates health-related sensory devices with the healthcare center cost-effectively. It can aid senior citizens and patients, especially elderly, who need long-term attention to their physical condition, like chronic diseases and falls, with ubiquitous surveillance and remote management of the recorded health data, and timely help. Dr. Subhas Chandra Mukhopadhyay and his team have done a lot of work about ADL monitoring of elderly people in the smart home [14].

#### 1.1.1.1 PRELIMINARIES

The main problems that arises in the automating the home are

- Connections of Appliances
- Intercommunication
- Controlling

As far as the first problem is concerned numerous protocols have been designed. As the recent product comes with support of many protocols like

- Bluetooth
- Wi-Fi
- LAN
- Infra-Red
- UPnP(universal plug and play)
- ZigBee

As for now we are skipping this protocols as it is not of our concern. As we are well aware of this protocols. Intercommunication can be well achieved by the above protocols. Moving onto the third problem that is controlling of the appliances. This issue can be handles in two ways. First, by using traditional digital and microprocessor based systems like discussed in [13], [17], [19]. Second method for this is by using the sophisticated processing of artificially intelligent clients. The first method is more common as hard coding the controller based on various parameters can be cheap in cost but due to efficiency of the system it is rejected as it will be doing the same thing for 24 hrs 365 days irrespective of the climate or external environment change. So if the system is called smart or automated then it should be versatile and to change the internal parameters with respect to external parameters. Management of house done by Artificial Intelligence is what we will discuss in this paper. As the meaning of artificial intelligence is to emphasizes the creation of intelligent machines that work and react like humans.

Some of the activities computers with artificial intelligence are designed for include:

- Speech recognition
- Learning
- Planning
- Problem solving

Artificially intelligent system consist of an eye that is cameras, Ears that are microphones and mouth and hands that is Speakers and triggering system respectively. We will now see the management of home using Artificial Intelligence.

### 1.2 MANAGING HOME APPLIANCES

The first service that a user expect from the home automation system is the comfortable management of appliances. E.g. the cooling rate of a cooler depends upon the surrounding temperature so if the temperature rises then the cooling rate should be increased.

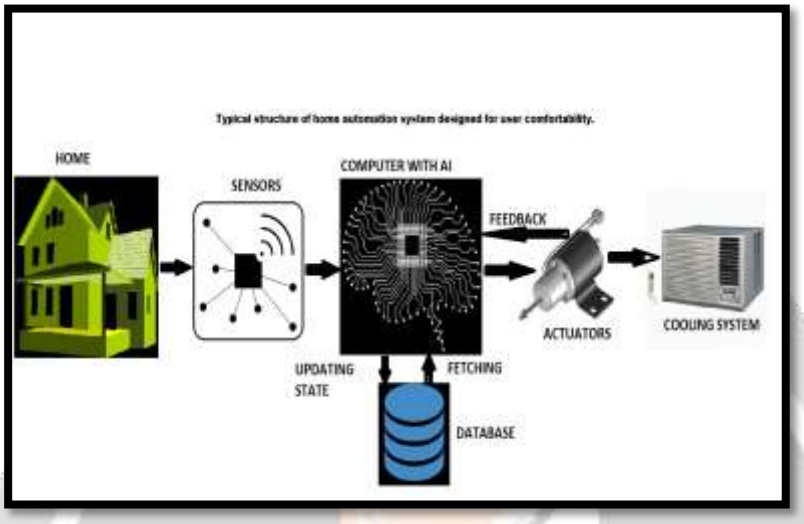



**Fig.1. Typical structure of home automation system designed for User comfort ability**.

Features of above structures are:-

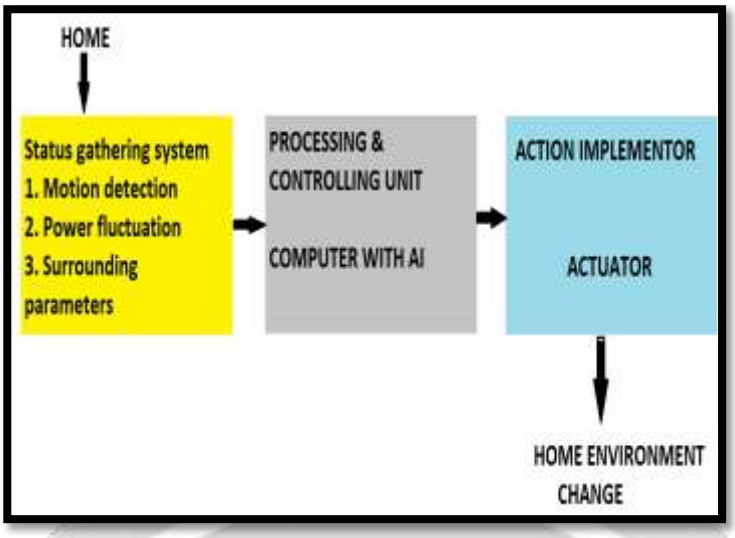
- Feedback System is used.
- Sensors are highly calibrated to sense small change in surround
- Actuators are used for turning the regulators or IR based remote accessing can be done.
- Computer with AI can be used for action performing or task scheduling. Due to auto learning system can adjust the threshold value which can vary with time and surrounding environment with respect to external environment.
- Ex. AC adjustment done by user in different seasons.

### 1.3. REMOTE CONTROLLING MODE

Remote accessing of the device is for device management is necessary for controllability of the system for debugging or analysing purpose. For e.g. Suppose if you are going home and you wanted your home to be cooled by the time you reach, then there are two ways to do that either take control over the system using command and set the threshold or just update the database of the system with your threshold by overriding the database update control through application. For this user is given a secret code for overriding of the system database for authentication needs as security is our main concern.

Following are main points to consider about this class of Systems:

1. Authorizer and Receiver is an electronic system capable to receive the control signal. As discussed in Section-II there exist a number of such systems any of them can be used for this purpose. One important thing about this System is that it requires some authorization mechanism to ensure that the request is authorized one. For this purpose we can use some cryptographic techniques to encode and decode the request so that only authorized user can access the network.
2. The decision maker system is an AI based agent that can decide what action should be taken in response to received query. There are other ways to implement this step but using of logic circuit is costly complex and hardcoded thing or static value system.




3. The third object is actuators which we have discussed in previous section.

**Fig. 2. Typical structure of home automation system designed for remote management of home devices**

## I. EFFICIENT USE OF EVERY APPLIANCE

Not just in home industrial automation is also a topic to see as power wastage is more in office than in house. For e.g. if a person is sitting in his office with ac and light on and due to some work he leave his office unattained then the power wastage is occurred. So system should be so much efficient to check whether any person is inside the office if no then turn off the ac and lights as soon as person enter his\her cabin the previous state should be triggered. In such a scenario, we are supposed to have some automation system that can continuously pole the environment and can decide the appropriate action whenever needed. These systems should fast enough for responsiveness and effectiveness.

Fig. 3 shows the typical structure of the system that can provide this class of services. The working of the components of the system is as follows:

1. The status gathering system continuously senses the environment conditions and forwards the sensed condition-factors to analyser and knowledge based database at computer with AI block.
2. The Analyser receives the current environment condition from status gathering system and with the help of database it analyses the variation in the environment. Now, depending upon the variation Analyser gives the instruction to Actuator
3. Again here the actuator is similar to the actuator discussed in previous sections.

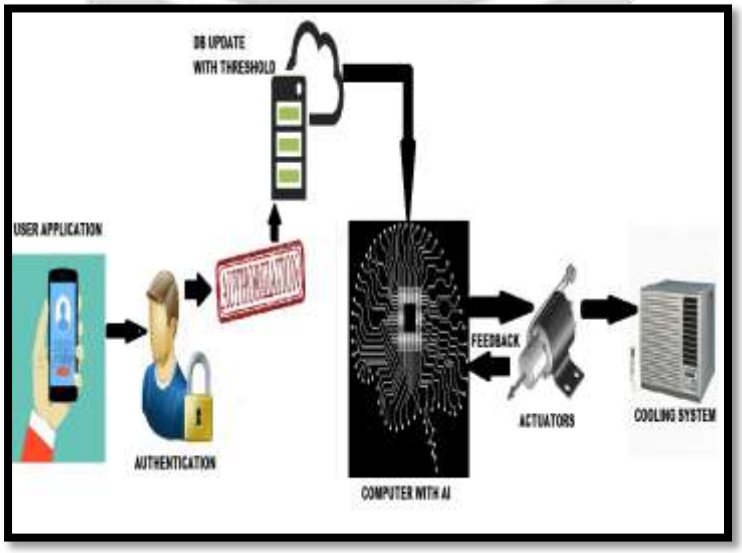


**Fig. 3. Typical structure of home automation system designed for optimizing**

The major differentiating factor of this system from previously discussed systems is that this is sequential while previous one was atomic, because, in this system the action to be taken depends upon the present & previous environment conditions.

## II. SECURITY

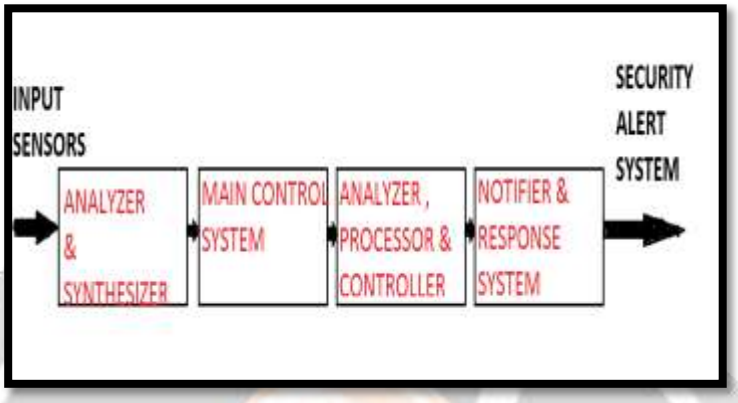



**Fig.4. Typical structure of AI based secure home.**

The description of how system works is as follows:

- Security sensors sense the environment for security threat.
- The analyser and synthesizer analyses the data received from the sensors and filter out any security threat. If it found any security threat, then it sends the sufficient information to reasoning system.
- The Reasoning system apply the reasoning for detecting whether the security threat is really a threat, if yes then it fires the security alert system for alerting the user about this security threat by analyzer.
- This analyser is same as used at the second stage but opposite in nature. The previous converts the physical information into digital form while later one converts the digital information back to physical form to alert the user.

## III. APPLICATION OF AI IN HOME AUTOMATION

So in Section-IV, V, VI and VII we have discussed about the home automation taken one class of services at time. Now, in this Section we will concentrate on the application of AI in all the four forms of home automation system one by one.

### A. Use of AI in Comfortable Systems

In these systems the application of AI is limited as most of the part can be easily implemented using some electronic circuitry. Here the only part where the AI is effective is the knowledge based database which should be learnable (as discussed previously) for system to be truly comfortable. Since AI tools are little bit costly it will increase the cost of the system but will make the system more comfortable, flexible, easy updatable etc.

### B. Use of AI in Remote Controlling Systems

In these systems AI can be applied in the authorizer as well decision maker stage. Applying AI at the authorizer will increase the responsiveness and security and is more applicable when the environment under consideration is an industry where security is a major concern (e.g. Banks). On the other hand, Decision making part can utilize the case based reasoning of AI for effective and efficient management as it has to decide that which of the target device is corresponding to this particular instruction.

### C. Use of AI in Optimizing the Resource Performance

In this system AI can used to implement knowledge base as discuss for previous systems and for Analyser as it makes it more efficient in deciding the particular action. Moreover, if analyser is learnable from its experience then it will make the system more optimized.

### D. Use of AI in Secure Systems

The biggest use of AI is in these systems. Here we can apply following tools of AI for various applications:

- Video Processing for security threat analysis
- Image Processing for security threat analysis
- Audio processing for security threat analysis
- Knowledge base system for Security system database
- Case based reasoning for analyser and synthesizer
- Decision Making in Security Checking and Decision

From the paper we came to the point for need of Artificial Intelligence in any type of automation to enhance the capacity of automation and efficient use of devices connected to it.

## 2. CONCLUSION

In this paper we started our discussion with home automation system by defining four major applications of these systems which are user controllability, remote control, efficient resource utilization and security.

The proposed system consists of major applications which are comfort ability, remote control, optimal resource utilization and security required in home automation. Cheap in cost with respect to available product in market. Future upgrades can be installed easily. Solar Panels are provided to charge the battery during day time to reduce power consumption for battery charging. Auto and Manual mode gives system and user some control over system. Iris controlled system can be viable input method for differentially abled person. Using of feedback system gives system acknowledgement to prevent system from unnecessary triggering of devices.

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