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AUTOMATION APPROACH ON SMART BUILDINGS AND ADAPTIVE CONTROLS USING IOT

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ABSTRACT

Abstract—Now-a-days automation has become an important aspect in various fields. But how successfully will it be working in the real time application will be the major question. Automation is come into consideration since ages, but people couldn't recognize its automation out of it. Keeping these things in mind automation is being taken to another level where-in we can automate the things according to our desire usage with the help of internet. Internet was evolved for basic communication between people, it has been further continued to communicate between the humans and their appliances. This application of internet on appliances is called as Internet of Things (IoT). Smart buildings showcases itself as key environment for the enhancement and growth of efficient and sustainable cities. In accordance with vigorous development and growth of Internet of Things (IoT), the integration of amalgamate IoT devices urges the services to get completed effectively and further consider the decisions respectively. Home automation and Industry automation has evolved effectively and helping the mankind since early 21st century. But we cannot bind it with this application, hence this paper enhances the IoT technology followingly engraves the Smart Building approach to the mankind. The paper concentrates on transforming a usual building into a smart building, by using the concepts of IoT and home automation. Multiple modules being covered under IoT will be integrated under a single code and interfaced which will bring the concept of automation into making a building as a smart building. The paper at the end engraves the IoT technology and its extensive usage under the concept of smart building. That particular building can be able to work smartly for parking slot indication, lights at the corridors, water usage by STP, Earthquake detection, Security used for Gates, Disaster like smoke and fire extinguisher, HVAC optimization etc.

Keywords: *Keywords— IoT technology, Automation, Smart Building, Smart Parking, Smart Lighting, Water flow Sensor, Earthquake detector, Disaster control, Smart gate, security, HVAC optimization, Arduino.*

I. INTRODUCTION

Automation is one such field now-a-days people are attracted to. It's been the era for home automation and is ruling the mankind with its fast growing technology and immediate following-up of results. As the 21st century is focusing on wireless transmission of data, this helps in controlling the devices in homes remotely. Any system developed through this technology would help to automate the functions switching-up lights, parking system, earthquake detector, water flow sensor as well as the smoke detection (HVAC). Smart home systems are different from ordinary home, where different smart devices in the presence of communication network being installed that allows the devices to communicate with each other. By using the technology of the IoT, the execution of home automation have got additional averages. IoT can be explained as a package of sensors which can be moduled with programming codes which end results the output as desired. There is an increasing demand for smart homes, where appliances react automatically to the conditions and can be easily controlled by the devices. Home automation is the residential extension of "building automation" and provides comfort, improved convenience, security and energy efficiency.

II. EXISTING SYSTEM

At present the technology is showcasing the IoT under Home Automation and it smart. Smart Lightings are used inside the houses to switch on and off the lights in accordance with the human presence. Fire extinguisher is available for small coverage of area and indicates the particular owner for help or rescue. HVAC optimization was

done manually, now-a-days it is also being automatized. The literature survey mentioned in the next sub heading will give us the brief details on the existing system. [1] This paper gave a solution to the physically challenged people suffering from quadriplegia or paraplegia in a very low cost by the home automation system that can be controlled through voice recognition. Also this technique was extended to the elevation of bed at the comfort and need of these people. The input is taken from microphone in the form of speech and given to voice recognition module. The comparison is performed between the voice that was previously stored and the controller takes the required action if the voice is recognized. The actions performed are alerting through buzzers, bed elevation and turning on/off the lights. [2] This paper proposes a cloud system for Home Automation using the integration of wireless communication based on the Intel Galileo, cloud networking, and provides the user the technique of controlling the various appliances such as fans, lights inside the home and store it on the cloud. The cloud structured system updates the sensor's data automatically. Intel Galileo development board, has an inbuilt Wi-Fi port where the card is inserted and acts as a web server. Automation can be accessed by any web browsers of any local PC using the server IP address of the LAN works remotely from mobile handheld devices connected to the server IP. The network infrastructure for service and sensors are Wi-Fi technology. Wi-Fi improve the system security also increases the system mobility and scalability. [3] This paper proposes an algorithm for the gesture recognition of hands by the images of the hand. Initially, regions are detected and then the interface is made. Movement of the fingers that involves gesture recognition technique for hand gesture recognition consists of the following steps.

1) Skin detection by localizing hand like regions.
2) Fragmentation and false region removal
3) Discovering convex points contour
4) Determine farthest points from convex vertex
5) Filter out convexity defects
6) Finding finger count from defects

This paper describes how to control and monitor the home appliances using an Android application over the internet. Android mobiles are used to send the command to the Arduino controllers to control of the home appliances. The main system features do control the voltage levels of the appliances such as the speed of the fan based on the temperature or the intensity of the light and many other features. Different sensors like temperature, LDR are used for different applications. [5] In this paper, the security for the home automation system is proposed. The system operation supported by GSM embedded mobile module, enable the alert message to both the end users and the central security office. The proposed system is built on the microcontroller module, on an embedded platform. The system operates on different levels for the users easy access control, based on the password policies. Every time user and the security office the operation mode via the GSM network. [6] In this paper, status of the appliances I sensed by the sensors updated the web server. If the user is far away from home then he can access and change the appliances status the life and humidity and temperature. Users can use the local PC. This paper describes the controlled by the web server. Server monitors and controls the various sensors. It can be configured to handle more hardware devices and sensors. The Intel Galileo development board with inbuilt Wi-Fi port acts as a web server. [7] This paper proposes the basic design of the internet of things which is mainly based on the home automation system using Raspberry Pi technique. This project builds a home automation system that controls the home appliances by any mobile devices. The home automation system is mainly based on IoT. Raspberry Pi very large number of peripherals. They have different communication media like the HDMI port, USB port, camera serial interface, Bluetooth, digital serial interface, Ethernet port, Bluetooth low energy. This allows to control the home appliances. The local server is created on the Raspberry Pi. User uses different mobile devices like laptop, tablet, and phones to control the home appliances with the help of web pages. [8] This project presents a flexible low cost home monitoring system using the Raspberry Pi module and static relay, with the internet access how to control the devices and appliances smartphone Android application. Demonstrate the flexibility and effectiveness, devices such as static relay and the Wi-Fi router can be integrated to control the home system. This project is concerned with the control of the light and the home machine, control of door and home security automobile using the internet as communication protocol interface and Raspberry Pi as a Processing Unit. The users can send the commands using the Android applications and control the devices. The data were analyzed over the network what's the application. Raspberry Pi add to the server the analysis of the data is done and activate the general purpose input output (GPIO) pins. These pins are connected to the relay which activate home appliances. [9] This paper proposes the idea of the

home automation system with a very low cost wireless communication between Raspberry Pi module and Android based application. It provides a combination of two components- security and ease of lifestyle for the people. This paper is used to control the electrical appliances in the home or office using an Android application. The main control system is used to implement the wireless technology to provide the remote access from the Raspberry Pi module. The paper mainly focuses on the monitoring and controlling of the smart home and providing security to the user away from the home. It controls all the electrical devices or the appliances in the house to lower the cost and provide a user friendly interface for ease of installation. The Android phone is used to control the various parameters of the home appliances. The project aims at implementing the following:

1) Smart doorbell
2) Regulating appliances
3) Reminders
4) Alarms\
5) Wireless speakers

This paper provides a flexible and very low cost effective home automation system with the integration of the micro web server internet protocol, connected classes and control the equipment of the devices using Android based smartphone application. The proposed system defines the new communication model protocol for the purpose of monitoring and controlling the home appliances. This project is intelligent way of operation for the fans and lamps. Here the system would be connected with lamp control and temperature control sensors for the maintenance of light and temperature. For automatically controlling the operations with the light and fan the sensors such as Light dependent resistor (LDR) and temperature sensor (LM35) are components mainly used. LDR is mainly controlling the lamp intensity and LM35 is mainly responsible for controlling the operations of a fan. System implemented with a smartphone.

III. PROPOSED SYSTEM

Multiple modules being covered under IoT will be integrated under a single code and interfaced which will bring the concept of automation more further by adding the following features into the smart buildings, the objectives of them are;

A. Smart Parking

Displaying the available slot at the entrance, using RFID tag and receiver the slot booking will be carried out.

B. Smart Light

Switching on the lights automatically when the sun sets, during darkness.

C. Security (Smart Gate)

The Once the RFID receiver detects the tag and ensures the availability of the slot, the gate is opened and according time is noted down as the start time for billing.

D. Smart Water Meter (Using in STP)

Amount of water consumed and treated back using STP is just claimed by the apartments. In order to know the exact amount of consumption.

E. HVAC Optimization (Heaters, Ventilation, Air Conditioner Optimization)

When there is more amount of heat or excess in temperature, the ventilators gets opened. Accordingly with the excess of Smoke eruption too and maintains the temperature with respect to number of people present at a particular place.

F. Natural calamity Indication (Earthquake indicator)

We cannot prevent the natural calamities but at least we can create an indication and prevent haphazard taking places which costs the human lives.

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G. Disaster Control (smoke and Fire control)

When there is any disaster like smoke or fire eruption, then automatically using buzzer alarm the indications are made and according measures are taken.

From below figure 1, we can understand pictorially, the main Phases are central processor, communication (networking), NodeMcu, Sensors, Application, Domestic Automation, Building Automation, Output & Disguise, Dashboard, Result, Solution to the prescribed problem. The Central processor constitutes of main programs for all the available sensors and processes the compilation process of all the devices present in the use case model. From central processor the information (sensor code operation) is sent to two way process, one for communication (networking) and another for perception (sensor). When both of these are integrated together, the output is evolved. From the central processor the main code is sent to NodeMcu, through which it is further sent to the available sensors, these NodeMcu and sensors are either connected with analog or digital connection through a breadboard together. If it is not wireless communication then, the information is now carried out via RFID tags and RFID receiver and further which its information is sent to its respective functional sensors.

Once the sensors works accordingly to the code produced, its result (whether right or wrong output) will be processed in processing phase followed by Application phase. In Application phase we have Domestic Automation and Industry Automation. As, we are only concentrating on Domestic Automation specifically on the Building Automation which consists of Parking, Lighting, Gate, Water flow, Earthquake detection, Smoke and Fire Indicator, HVAC Optimization. Finally the output of all of these are being sent to a dashboard. Through Dashboard we can decide whether the output should be sent to the serial monitor or should it be sent to integrated mobile phone. By doing any of these we do get the solution as an end result for the main problem definition.

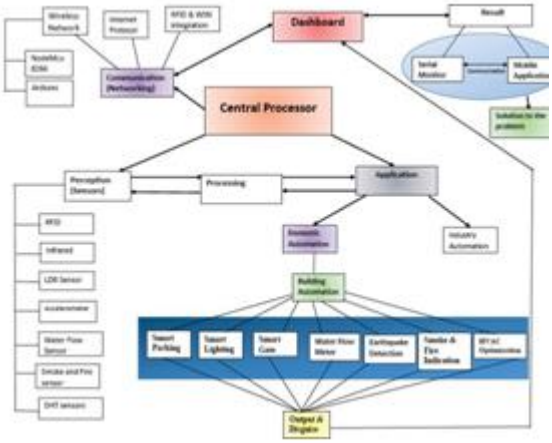

Fig 1: Block architecture for the proposed system.

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IV. SYSTEM DESIGN

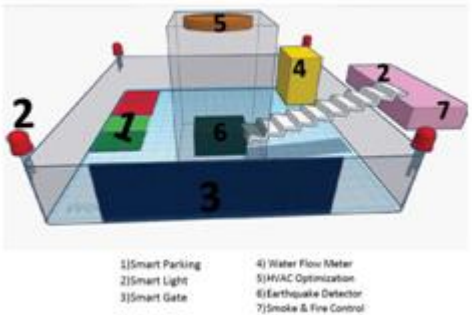

Fig 2: Design architecture for the proposed system.

From figure 2, we can pictorially understand the concept of Smart Building and its modules. It consists of a building in a bounded area. In addition to this we are considering parking bay, water flow measuring, lights, HVAC optimization, and Earthquake detector, Corridor space for HVAC and lighting effects.

A. Smart Parking

A Parking a vehicle in a crowded mall or any parking building site has become a tedious job for the driver, as he/she should go in search of parking bay available in the parking lot. In order to avoid this, Smart Parking helps us to intimate the empty parking bay available. This would be displayed at the entrance through which one can receive the ticket at the arrival. In addition to this an individual gets an opportunity to book the parking slot before arrival to the Bay. Using RFID technology the car will be having a unique tags and that of the receiver will be attached near the entrance. The tags will get sensed and its unique code will be entered. Consider an example if a car1 is entering into the parking lot and before that car2 is already entered, but for the feasibility LED are attached with respect to the IR sensor. If the LED is glowing RED then the parking bay is full, on the other hand if the LED is glowing GREEN then it indicates that the parking bay is empty to park. After the work if the car want to exit out of the bay, using RFID receiver the tag senses it and the end time will be availed and with its timings the amount will be billed.

The above mentioned method is possible when IR sensors are used. An IR sensor is an IoT based electronic device which uses infrared radiations to send and receive the data back from the obstacle. The time taken for a signal to travel back from sensor will be converted and intimated as precise distance travelled (distance of the obstacle)

Fig 3: IR sensor

B. Smart Lights

It has become a tedious job for an individual to switch on each and every light switch in the building. We can yet reduce the effort by using IoT automation, i.e. by connecting the every available light connections to single host, it automatically switches the light on during evenings and turns it off in sunlight. The Steps and corridors of the building will also be having the above mentioned technology, but with addition to this it has dimmed light when there is no human moment, if there is any moment then the light should become brighter.

The above method can be practically possible by using LDR sensor (Light Dependent Resistor). This sensor consists of a photo resister and switches on the light only when there is lesser amount of light, lesser than that of the threshold limit being set. Further we can make use of PIR (Passing Infrared Radiation) in the corridors, this works on the temperature of the movement made in its radius.

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Fig 4: IR sensor

C. Smart Water Meter (Using STP)

There is scarcity of water now-a-days, we are hardly trying to conserve it. Taking that aspect into consideration we have come up with an idea by which we can measure how much water is being recycled from a building. Many of the apartments do quote that they have STP (Sewage Treatment Plant), but how well is it feasible and used. In order to keep that into track we can apply this automation approach towards ST Plants in the buildings. The device provides us the actual water consumed by the building and measure of water which is being sent to STP for the treatment and its usage.

The above methodology can be implemented using the device called as water flow sensor. The sensor intakes water, measures the flow of water by using mini turbines, number of rotations done through the flow of water constitutes the result at the output.

Fig 5: Water Flow Sensor

D. Security (Smart Gate)

Any intruder trying to enter a building he/she should do it using the fences, when these fences are kept secured the only way out would be the main entrance. Keeping that entrance secured is an important aspect. Hence, using IoT technology and camera module, we can modulate and regulate the incoming and outing of every individual by opening the gates only when there is an entry of the vehicle using the RFID tags.

Any car entering into either an apartment or any other paid parking building, should consist of a RFID (Radio Frequency Identification) tags. These tags helps to get into contact with RFID receiver present at the entrance. Once the RFID is valid the gate opens for the authenticate user and starts the billing form that particular time and bills until that particular car with RFID tag is exited. In addition to Tags and receivers we use servo motors which operates like stepper motor and opens for desired angles.

Fig 6: Servo Meter

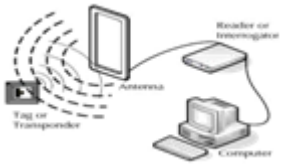

Fig 7: RFID Card transmitter and receiver

E. Natural Calamity Intimation (Earthquake Detector)

In our daily routine we do have conscious on the natural calamities, but we do always wait for the news for us to reach as an intimation. Hence, by using IoT we did think of to develop an intimation before the earthquake. i.e. Whenever there will be an earthquake, just before sometime of it there will be an intimation given to those building.

Here Accelerometer sensor can be used to detect the earthquake vibration. An accelerometer is a device which enses the vibrations caused, in this proposed system there is some threshold magnitude set. By doing this after certain threshold magnitude it does intimate to the main server followed by intimation towards that particular building.

Fig 8: GY-61 DXL335 3-axis Accelerometer

F. Disaster Control (Smoke & Fire Control)

Disasters like fire or smoke eruption can be controlled using the above technology. If at all there is smoke eruption in the building like CO, Methane oxide etc. which can cause harm to the human kind, will be detected by this sensor and its sensing report will be sent to the HVAC through which the ventilators at that portion should get opened by the port and the smoke should be sucked out of that area. Similarly while the fire eruption, it should detect the intensity of the fire and indicate the respective department also spray the water in that particular area.

The method can be made possible by using the smoke detector device. It Senses almost all types of gases and smoke, if there are any new kind of smoke then it should be preset initially and then to be used for sensing. MQ-135 is the smoke sensor used in the proposed system which senses the gases like CO2, CO, alcohol and other harmful gases which are toxic to human sustainability.

Fig 9: MQ-135 Smoke Detector

G. HVAC Optimization (Heater, Ventilation, Air Conditioner Optimization)

Consider an example of server room getting heated up, it should be considerably cool though. Yet if it gets heated up using HVAC technology we can cool up the server room by letting out the ventilation or by switching on the Air Conditioner. If there is emission of harmful gases like CO, MO2 etc. when crosses its limit which leads to life threats, hence HVAC comes into force by which the ports get opened following which using fan turbulation the smoke will be let out. Similarly when there is smoke or fire eruption, to let the smoke out the ventilators opens up automatically.

V. RESULT

The working model of the above methodology gives the indication for parking slots, lights are switched on when required, gates are opened only when the registered car is trying to enter or in public buildings it does consider for paid parking and charges the parking accordingly, water consumption and usage is monitored for STP, Earthquake occurrence can be detected and respective measures can be taken, smoke and fire can be eradicated using smoke detectors and ventilated using HVAC optimization. The following screenshots below explains the output of all the modules.

- Accelerometer is a device used to measure the vibration along the axis(x or y or z) specified. We have considered only the x-axis for the detection of the vibration. This sensor initially reads the x-axis value below 500. A threshold of 505 is set to check for the occurrence of vibration. When the set threshold is exceeded then the vibration is created indicating the earthquake has been detected with the help of a buzzer as an alert.

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- DHT11 sensor is used to detect the temperature and humidity of the environment. When the sensor is able to successfully read the temperature and humidity it collects the data and displays on the output screen. Temperature read in Celsius degree. If the sensor fails to read the data it displays a error message.
- An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. It can measure the heat of an object and detects the motion of an object. These types of sensors measures only infrared radiation, and in this project is used detect the parking slot is either booked or empty. Initially the slots are free, the slot becomes booked when the vehicle is parked. When all the slots are booked it gives alert message.
- Light Dependent Resistor is used to detect the light intensity, it has a resister in which the resistance decreases as the light intensity increases. Here, the intensity of light is measured in voltage. When the light intensity is more, voltage drops down and the light would be turned off otherwise the voltage value increases and the light glows brighter depending on the light intensity measured by the sensor.
- Radio Frequency Identification uses electromagnetic fields to automatically identify and track tags attached to objects. The tags contain electronically-stored information such as access token.
- When the correct identification is provided only then token is allowed to access the gate during the interval of entry and exit actions. If token is unauthorized then an error message would be displayed as the denial of the token.
- Servo motor is used to access the gate control. When the RFID tags are detected the Servo Motor rotates at the specified angle either to open or close the gate.
- Smoke sensor is used to sense smoke as an indicator of fire. Initially the value of the smoke detector sensor would range between 500 to 1500. If, there is a smoke detected then the value ranges between 20-300, through which an alert would be given in the form of buzzer and the electricity is turned off.
- Water flow sensor is used to detect the amount of Water used. It contains a rotor through which the flow of water is detected here we calculate the total flow rate, the amount of current liquid flowing and the total quantity of output liquid in liters.

VI. CONCLUSION

The proposed system in this paper will give us the above result which would reduce the human work and work smartly for the indication of any kind of disaster. This methodology integrates the above mentioned codes with the mentioned sensors and makes it work as desired. The output shown above intimates about the working methodology of smart building, by using less amount of electricity with respect to maximum output. The end product in real time will be helpful for the human mankind for making their life and activities more interactive and much simpler life. Thus saves many lives and helps the society.

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