A REVIEW ON SMART HOME TECHNOLOGIES

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Abstract— **In the near future Smart homes will be the benchmark of next level comfortable homes. IOTs like node MCU, GSM module, Arduino has been pushing smart technologies to new limits in last few years. Smart homes will be important not only on comfort perspective but also for effective and efficient use of electrical energy thereby resulting in reduction of our daily energy consumption and minimising wastage. This paper highlights the fundamental concept of smart homes and some important smart home technologies that can be implemented. The paper as well includes challenges of smart home.**

Keywords— Arduino, sensors, Smart home, home automation, smart irrigation system.

I. INTRODUCTION

The concept of smart home and buildings is being treated as one of the most popular emerging ideas in present world scenario. Smart building is a type of building with reasonable investment, efficient energy management, and comfortable and convenient environment, designed by considering the optimized relationship among structure, system, service, and management. It is the outcome of the application of information technology and control technology into traditional buildings as well as ample internet availability. With vast expansion of digital technology and internet facilities, implementation of different ideas related to smart home has become much more feasible than before. With increase in demand of residential complexes and consequently reduction in natural resources designing energy efficient buildings is the demand of the hour. These systems involved in smart homes can be safer, more convenient, energy saving as well as time saving gifting us intelligent home life. User-cantered intelligent design promotes the sustainable development of smart buildings. It gives the user, the ability to control any electronic device without even reaching out for a remote controlling unit.

The network is required for communication of the automation to the controlling device. It can be both wired and wireless. The controlling devices are used for managing the system, IOT or internet of things is an upcoming technology that allows us to control hardware devices through the Internet.

II. BACKGROUND OF SMART BUILDINGS

The 80s' observed shift towards intelligent buildings which perfectly also matched up with the worldwide property boom towards the end of the '80s. There was also a requirement for these new buildings to be as efficient as possible, and therefore the concept of "intelligent buildings" could fill this void. The advancements in technology and different environmental factors directed to the conception of automated building systems which formed the fundamental concept of "intelligent buildings", a term first coined in 1981 by the United Technology Building Systems (UTBS) Corporation, United States. Initially, intelligent buildings used single and multi-function electronic systems to centrally control certain physical factors like heating, ventilation, and air conditioning systems thereby improving building efficiency and minimizing energy consumption via the integration of information technology. In 1991, with the easy availability of internet to the public changed so many aspects of lives of people, including their way of working in professional fields, mode of communication, and interaction with technology. Buildings began to change as well. Offices were encouraged to a more open-plan environment to encourage people to be more collaborative. This resulted in need of buildings to be as energy-efficient as possible. With the introduction of the internet which became much more widely available, these intelligent buildings were developed to be "Smart Buildings" in the 2000s. People are much more conscious of the changing environment and want to reduce our

effect on it. A major percentage of the common people is but unaware of ways by which we can contribute to the sustainable development.

III. IMPORTANCE OF SMART HOME IN MODERN TECHNICAL SCENARIO:

- *To saving unnecessary energy consumption: -*

The smart home technology industry mainly focuses on reducing unnecessary use of electrical energy. However, it does not implies that smart home technologies will reduce home energy use overall.

- *Wireless control of home appliances (Switch and Voice mode): -*

Development of application would include features of switch and/or voice modes to control the applications which will significantly reduce human efforts. In this time where we are avoiding contacts to avoid spread of identified and unidentified viruses, having voice mode control is a blessing.

- *Monitoring status of appliances: -*

It gives the option of being aware of the energy consumption or the mode of operation. Being able to view the status of home appliances on the application, helps to have a better Home Automation System.

- *Extensible platform for future enhancement: -*

With a strong existing possibility of adding and integrating more features and appliances to the system, the designed systems will be highly extensible in nature.

- *User friendly:-*

The systems are extremely easy to use once designed. The applications are mostly through mobile applications. The increased smart phone literacy makes the application of the technology user friendly.

IV. SMART HOME TECHNOLOGIES

The wireless communication system mostly used nowadays are microwaves, infrared (IR), radio frequency (RF), Wi-Fi, Bluetooth, and so on. Furthermore some of smart home network standard can work using both wired systems and wireless systems.

Some of the technologies which can be easily applied in residential buildings are:

- *Smart water level indicator with automatic water pump controlling system:*

In accordance with the recent scenario, there is huge amount of water wastage from residential areas, industrial and commercial areas which may lead to its scarcity in near future. Some areas are already facing scarcity.

Nowadays everybody has overhead tank at their homes. Objective of this system is to indicate water level and control the water pump to avoid overflow of water. The idea can be adopted and is used to determine and control the level of water in overhead tanks and prevent wastage. The most popular way to implement this idea is by using Arduino microcontroller; codes were written in order for it to perform as water level controller.
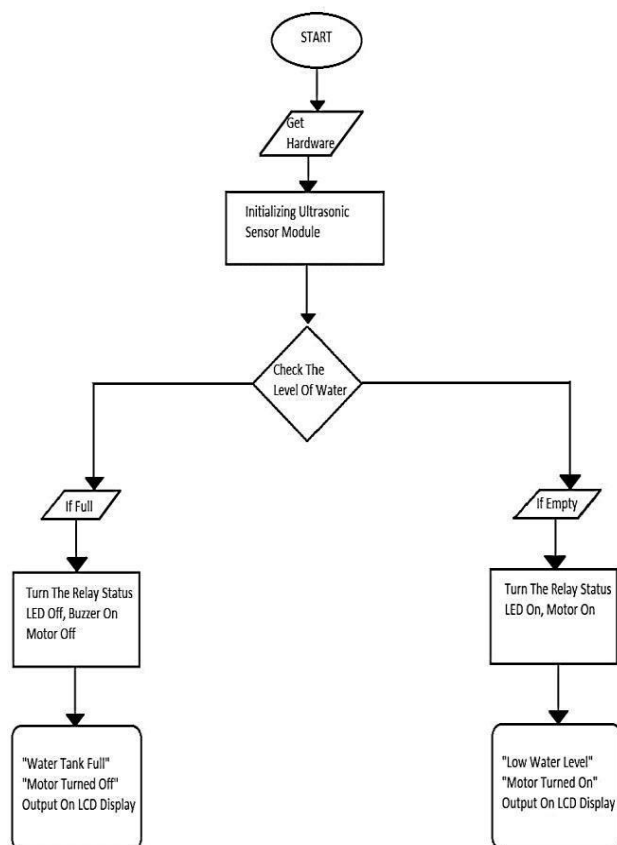

Fig. 1. Program Flow Chart

This smart system involves Ultrasonic sensor module which sends the sound waves in the water tank and detects reflection of sound waves that is ECHO. In order to do that we need to trigger the ultrasonic sensor module to transmit signal by using Arduino and then wait to receive ECHO.

Arduino calculates the time between triggered and received ECHO.

Distance= (travel time/2) * speed of sound

Where speed of sound = 340 metres per second. By using these methods, we get distance from sensor to water surface. After that to calculate water level we need to calculate the total length of water tank. As soon as length of water tank is known then we can calculate the water level by subtraction resulting distance coming from ultrasonic from total length of tank. And we will get the water level distance which can be easily calculated as the percent of water, and can be displayed on LCD.

The advantage of this system over existing conventional ways is that no one will be required to pay attention as to when the tank is filled and tank is overflowing. The system will therefore save a human resource and also the water resource.

- *Solar powered smart irrigation system:*

This concept is often implemented in gardens also as in green buildings and may also be controlled remotely.

This system can easily be developed using Arduino UNO powered by solar array. The system reads the moisture content from the sensor and switches on the motor when the moisture is below the set limit. When the moisture level rises above the point, the system switches off the led indicator. The status of the tank motor and therefore the moisture level are going to be displayed on a 16×2 LCD display. Monitoring of the moisture content of the soil is going to be done by employing a soil moisture sensor. The water level of the tank is monitored by employing a float switch which automatically switches off the motor when the reservoir is filled. The relay module controls the switching On or Off of the pump.

The advantage of this system over existing conventional method is that the reservoir will get automatically filled up as and when required. The soil will also have required moisture level. It will therefore help in avoiding under watering as well as overwatering of soil. Human resource and resource of water will again be saved.
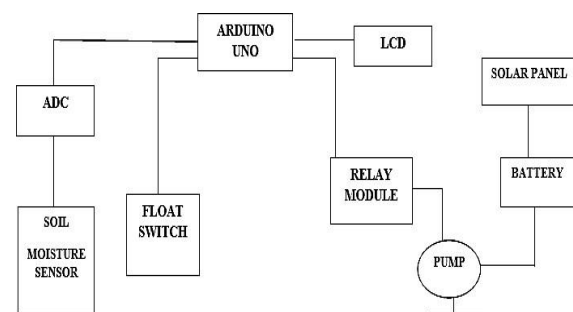

Fig. 2. Block diagram for Solar powered smart irrigation system

- *Smart home automation system:*

The home automation systems are used for controlling the indoor & outdoor lights, heat, ventilation, air conditioning in the house, to lock or open the doors & gates,

to control electrical & electronic appliances and so on using various control systems with appropriate sensors.

Home automation is a combination of hardware, communication medium, and electronic interfaces that work to integrate everyday devices with one another via the Internet. Each device has sensors and is connected through Wi-Fi to manage them from our Smartphone or tablet whether we're at home, or from any remote location having internet facilities. Sensors can monitor deviations in physical conditions of the environment. Home automation systems can then adjust those settings (and more) to our preferences. This is the expansion and advancement of wired automation which uses wireless technologies like IR, Zigbee, Wi-fi, GSM etc. Also, Node MCU with the Relay board is one of the most common hardware that can be used for providing the controlling of home equipment via smart phone.

The system involves the control of Node MCU's GPIO from a webpage on any device connected on the same network as the board. The status of the GPIO's controls the coil of the relays and causes the relay to alternate between normally open (NO) and normally close (NC) condition depending on the state of the GPIO, thus effectively turning the connected appliance "ON" or "OFF".

The advantage of this system over the existing conventional methods is that the system will help old aged, specially-abled people to operate the equipment from their mobile phone. The application can be used without the same switch being touched by multiple persons.
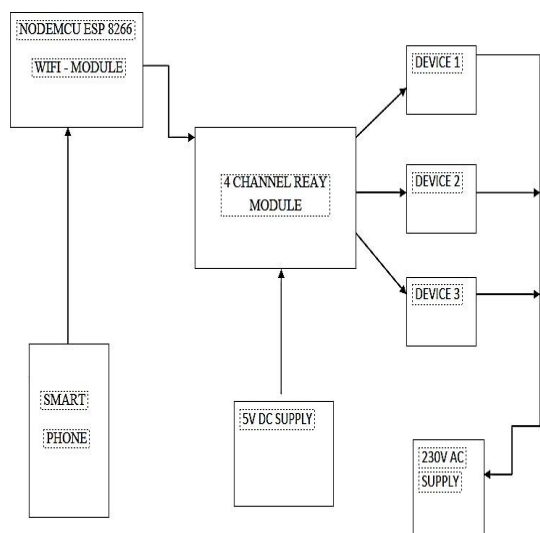

Fig. 3. Block diagram for Smart home automation system

The system will therefore be a low cost, reliable and scalable home automation system that can be operated by remotely switching ON or OFF any household appliance. The system would use a microcontroller and the result would be very user friendly. It may use short messaging system, voice call or a tap on app to switch stages. It may include an electronic smart metering system too. This system can be operated even if away from home. The smart metering system will keep the consumer aware of the energy consumption. The consumer may then plan and reduce energy usage.

- *Smart fire and smoke protection system:*

This system finds its application widely in kitchen for safety purpose. System will detect fire hazards and toxic

gases within a limited range. This system will alert anyone near to this incident by putting on the buzzer. This automatic protection system will automatically spread water. This system can be designed using Arduino, temperature sensors. If any gas leakage occurs then it will detect the gas with the help of MQ2 sensor. It will alert anyone near to the incident by using buzzer. Even if fire hazard occurs, it will detect it quickly and the alarming system will work again. This automatic protection system will automatically spread water if any kind of fire hazard occurs.

The system is cost effective and easily applicable to homes. It will reduce accidents due to gas leakage.

- *Smart light intensity controlling system:*

This concept finds a huge scope in lighting system of staircase, lawns, or outdoor lighting areas of the homes. This idea emphasizes automatic turning on or turning off lights that is decided by the intensity of natural light. It also ensures the efficient control of intensity of light in presence of object. If there is movement of object in a particular zone, the movement will result in glowing of the lights with maximum intensity otherwise light intensity will be reduced as a result of which power is saved to some extent. By using this system lot of energy can be saved. Whenever there is sufficient sunlight in surroundings, LDR behaves like high Resistance while in darkness this LDR behaves as low resistance Path and allows the flows of electricity, this LDR's operates with the help of IR sensors, these sensors are activated under low illumination conditions and these are controlled by an microcontroller. When any object comes in the range of IR sensors, as IR LED emits the radiations and reflected back to IR photodiode by the object. Hence, object is detected. The switching of the LEDs is operated through coding applied in Arduino using Arduino Software.

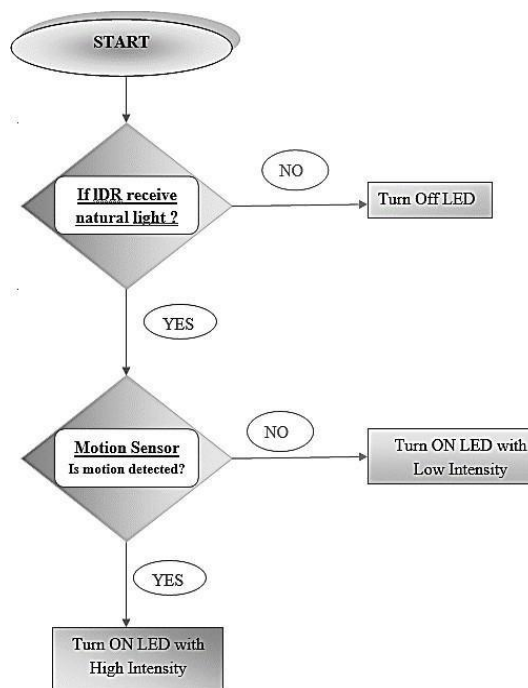The system helps avoiding unnecessary staircase lights being kept ON even when no one is there.

Fig. 4. Block diagram for Smart light intensity controlling system

V. SMART HOME CHALLENGES:

The main challenge of smart home is that all the appliances involve smart technology which may be very costly. During the consistent operation of various integrated devices, there may be delay or interruption with any new devices. Bandwidth consumption is another challenge for IoT connectivity. Managing bandwidth in home network also become challenging with the increasing number of personal and household devices. In a connected IoT network of devices, reliability of bidirectional signalling plays a pivotal role in for collecting and routing data between devices and in this case IoT data streams plays the role. All the devices in the smart home network may communicate to a server to collect data, or the server responds the devices effectively.

VI. FUTURE SCOPE:

The introduction of these technologies will bring a boom in the job generation for engineering graduates in both manufacturing and repairing and maintenance. The smart technologies will also awaken common people about the advantages of engineering.

The technologies may then be applied for small scale industries and also large-scale industries.

VII. CONCLUSION

New revolutions in communication systems and AI, has provided residential houses to reach new dimension of quality of life and security as well as reduction in energy wastage. Smart homes obviously have the ability to make life easier and more convenient. Smart home technology promises tremendous benefits for an elderly person living alone as they can easily fulfil their need via minimum physical effort. This paper based on the meaning of smart resident buildings and summarily description of few main points concerning smart home. these documents could provide a good basis of further research, design and eventual implementation.

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