Home Automation System using IoT

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Abstract—**This paper presents a low cost and flexible home control and monitoring system using an embedded micro-web server, with IP connectivity for accessing and controlling the devices and appliances distantly using Android based Smart phone app. The proposed system does not require a devoted server PC with respect to similar systems and offers a novel communication protocol to monitor and manage the home environment with more than just the switching functionality. To reveal the possibility and effectiveness of this system, devices such as light switches, power plug, temperature sensor and current sensor have been incorporated with the proposed home control system.**

Index Terms—IoT, IoT application, Smart home.

I. INTRODUCTION

THE Internet of Things (IoTs) can be described as connecting everyday objects like smart-phones, Internet TVs, sensors and actuators to the Internet where the devices are intelligently linked together enabling new forms of communication between things and people, and between things themselves . Now anyone, from anytime and anywhere can have connectivity for anything and it is expected that these connections will extend and create an entirely advanced dynamic network of IoT's. IoT's technology can also be applied to create a new concept and wide development space for smart homes to provide intelligence, comfort and to improve the quality of life.

In this paper, we extend our previous work and present a low cost and flexible home control and monitoring system using an embedded micro-web server, with IP connectivity for accessing and controlling devices and appliances remotely using Android based Smart phone app. The proposed system does not require a dedicated server PC with respect to similar systems and offers a novel communication protocol to monitor and control the home environment with more than just the switching functionality. We have utilized Restful based Web services as an interoperable application layer that can be directly integrated into other application domains like e-health care services, utility, distribution, or even vehicular area networks (VAN).

APPLICATION AREAS FOR THE INTERNET OF THINGS
➢ Smart cities
➢ Smart manufacturing
➢ Automotive
➢ Wearables
➢ Health care
➢ Precision agriculture
➢ Home automation

A. Smart Cities

Reduce cost and resource consumption with TI'sIoT products for outdoor lighting, surveillance, long range wireless connectivity, centralized & integrated system control and more.IoT is changing the way cities manage services, systems and infrastructure.

Smart solutions: City IoT

- Enhance infrastructure and deliver smart connected solutions such as smart lighting, parking and environmental monitoring.
- Create more efficient and cost-effective municipal services.
- Enhance public transportation, reduce traffic congestion and improve quality of life.
- Keep citizens safe and engaged in their community.
- Foster higher education and technology job opportunities with open innovation.

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Fig. 1. Smart city

B. Smart Manufacturing

Take your Smart Factory and Industry 4.0 project to the next level with TI'sbroadportfolioofIoT products and supporting tools, software and hardware.it connects the machines, date and people to streamline your operations and bring ground-breaking improvement to overall manufacturing processes and productivity. Smart manufacturing allows factory managers to automatically collect and analyze data to make better informed decisions and optimize production. The data from sensors and machines is communicated to the cloud by IoT connectivity solutions deployed in factory. That data is analyzed and combined with contextual information and then shared with authorized stakeholders.

IoT technology leveraging both wire and wireless connectivity, enables this flow of data, providing the ability to remotely monitor and manage processes and change production plans quickly, in real time when needed. It greatly improves outcomes of manufacturing reducing waste, speeding production and improving yield and the quality of goods produced.
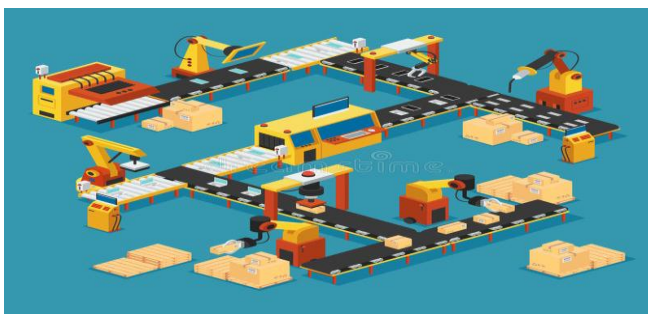

Fig. 2. Smart Manufacturing

C.Automotive

From headlights to taillights and all systems in between, TI offers a wide range of innovative technologies for the modern automobile. Regarding connected car engineering, offers best-of-breed IoT client SDK functionality that can be seamlessly embedded into different kinds of automotive hardware—from tiny sensors, control units and lighting to steering and engine
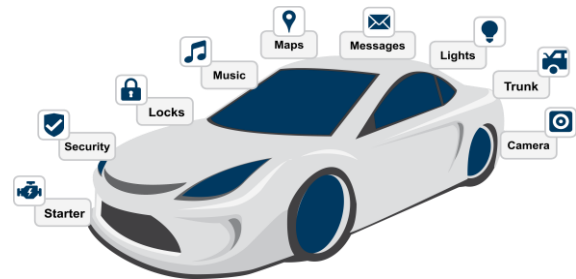
& drive train parts.

Fig. 3. Automotive

D.Wearables

With the broadest portfolio in the industry, TI provides in specific aspects is required to let people access and use the IoTwith the same simplicity highly efficient ultra-low power solutions for the wearables market. The evolution of mobile and wearable computing has changed the way people use online services by keeping them always connected, whether at home or on the go. In this context, there's a concrete need to fill the gap between mobile devices and the IoT. A paradigm shifts experienced when accessing the Internet and, possibly, to enable new and more natural forms of interaction, which will broaden the IoT user base.

Fig. 4.Wearables

E.HealthCare

The shaping technology to improve the quality and accessibility of digital products that are revolutionizing the health and fitness industries.
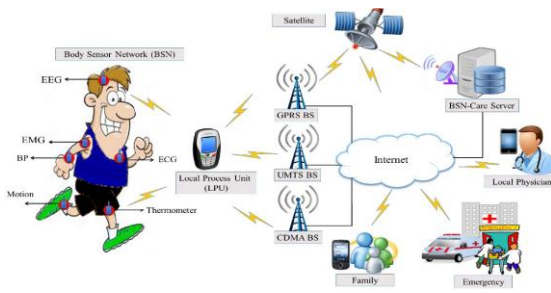
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Fig. 5. Health care

F. *PrecisionAgriculture*

Reduce time to market in your precision agriculture design with TI devices and reference designs.InIoT-based smart farming, a system is built for monitoring the crop field with the help of sensors (light, humidity, temperature, soil moisture, etc.) and automating the irrigation system. The farmers can monitor the field conditions from anywhere. IoT-based smart farming is highly efficient when compared with the conventional approach. Use of IoT in agriculture is mentioned by an author in a paper. However, it shows lack of interoperability which is necessary when we talk about large agricultural fields. In the year of 2015 concepts of IoT, cloud-computing, Mobile computing are used in smart agriculture.The system will start its working only after performing the user validation process. If username and password or neither of them doesn't matches, then the system will terminate it automatically.

Fig. 6. Precision agriculture

G. *Home Automation* System

Home automation has become more and more popular in recent years. It aims at helping people manage the home appliances freely and build an autonomous environment in home. The aim of this project is the home automation with full security and controlling the home appliances using wireless communication as Wi-Fi. We design this smart home system with the implementation of related software and hardware. To assure security the PIR and vibration sensors are used to detect the motion and vibration to prevent from theft. It alerts the people by buzzer and starts to record it through HD spy camera. The temperature and humidity of each room is monitored and maintained at room temperature using temperature and humidity sensors which activates the exhaust fan to maintain the temperature. The water level sensor is used to fill the overhead water tank without wasting the water. For these control purposes Arduino mega 2560 and ESP8266 is used because the arduino has the advantages of ease understandability and easily modifiable. The arduino board is specially designed circuit board for programming and prototyping with ATMEL microcontroller. The microcontroller used in this arduino is ATmega 328 which is in-built in arduino board and the coding are done in java script.

Home automation is providing home safety for dwellers. It automatically turns lights on in closets, stairways, and other dark places. Thus accidentally tripping or running into thing is decreased. Everywhere environmental issues are raised before introducing any technology. In this regard home automation provides a better solution. Devices included in home automation consume less power. Besides, it saves energy. Thus home automation technology is so far environmentally suitable. Moreover, the technology keeps mind in peace. In most cases, guardians face problems and always they keep tensioning for the safety of their children staying in home.

In home automation system internet access is used to control from far away. For years, internet is used only for surfing pages, searching information and downloading software and other things. Advancement of technology is forcing to make interaction internet with machineries and devices. In home automation system comfort and security of houses have been enhanced. Besides, people are concerning over costs. In offices, a division of people are employed only to make supervision of some manual means typed work. Home automation is replacing those arrangements. For this, cost is highly reduced. Besides, for manual labor engaged to control appliances waste energy in cases. It is seen that appliances continue to run though people are not present in their respective places. For this energy cannot stop consuming. If this happens for a long time, then there have possibility to misuse energy in a huge amount. To overcome this obstacle home automation is encouraged to apply. Home automation does that challenging work. That 'swhy; homeautomationispresentedasenergyefficient.Inrecentyears'homeautomationisgainingmuchpopularity. The trend is also in favor of using home automation technology. If we look around residences, malls, offices, use of home automation systems will draw attention. Early home automation began with labor-saving machines. Self-contained electric or gas powered home appliances became viable in the 1900s with the introduction of electric power distribution and led to the introduction of washing machines (1904), water heaters (1889), refrigerators, sewing machines, dishwashers, and clothes dryers. In 1975, the first general purpose of home automation network technology was developed. It is a communication protocol for electronic devices. It primarily uses electric power transmission wiring for signaling and control, where the signals involve brief radio frequency bursts of digital data, and remains the most widely available.By 1978, X10 products

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included a 16 channel command console, a lamp module, and an appliance module. Soon after came the wall switch module and the first X10 timer.

By 2012, in the United States, according to ABI Research, 1.5 million home automation systems were installed. According to Li et al. (2016) there are three generations of home automation:

First generation: wireless technology with proxy server.

Second generation: artificial intelligence controls electrical devices.

Third generation: robot buddy who interacts with humans, e.g. Robot Rovigo, Rumba.
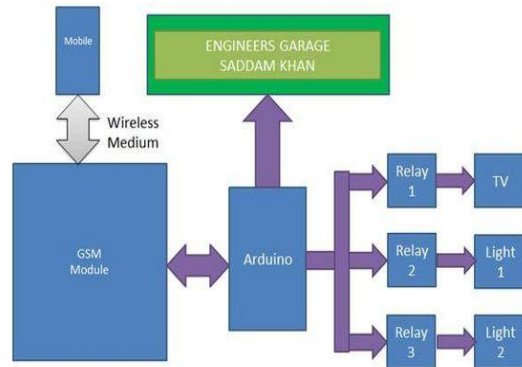

Fig. 6. Home automation

i. Scope and Benefits of IoT

It's the technology of today which is touching and transforming every aspect of our real life. IoT has given a concept of Machine to-Machine (M2M) communication. Some of the companies are implementing strategy to capitalize on the Internet of Things so that you can just stop your business and start making it thrives. IoT is going to have huge impact on home automation and building automation system where every convenience will be taken care of by the interconnected devices on IoT. It is also deployed on large scale for example in Song do, South Africa, the first of it sown kind fully equipped and wired smart city is near to completion (known as Ubiquitous City). With the personal electronics good connected to Internet will enable us to "author" our lives. In medical science field, IoT has given a privilege to devices and system to sense for coming disease and to prevent it, forge. It can make a person healthier with wearable's that can predict heart attack and cardio vascular strokes. As per a report consumer will start initiating the usage of IoT in a better way during 2015 and onwards compared to past usage. It is expected that IoT products with interoperable capability will dominate the market. Awareness of IoT products is also vital for market penetration along with security features. Even very few Americans are aware of the usage of these products. As per a study of Consumer Electronics Association and Parks Associates found only 10% of the household in USA fully understood the usage of these products. Many interesting IoT products like automatic door locks, Wi-Fi connected ceiling fans, light switches, LED bulbs, smart watches,3-D printers

and smart clothes will be popular among consumers. My Brain Technology in France has developed "Melomind". This EEG Headset can measure a human's brain waves and adjust music in a Smartphone app as they change. This product can be used as a digital meditation aid. A smart baby pacifier can measure the temperature of a baby and transmit the same to the Smartphone of parents.

Many scopes will be created for technology companies to release offerings as per the behavior of consumers. It may so happen that Netflix can know when a person is sad and alone by monitoring the smart watch, smart thermostat and in-home camera. Subsequently, Netflix may offer a movie to change the mood. In a consumer electronics show in Los Vegas, a branded company informed that the company would invest 100 million dollars for progress of IoT.

ii. Issues and Challenges

IoT is not free from challenges Issues of Goverance, security, Interoperability, privacy, regulations, providing power to billions of sensors and standardization issues can slow down the progress of Internet of Things. Due to the absence of generic governance, there is much confusion and inconsistencies. Absence of a universal numbering system is a bane for providing a true IoT environment. In the current context, systems like EPC Global and ubiquitous ID systems are used to address the issue of global ID systems. There is a challenge of implementing common security protocols. So, interoperability is an issue while interacting amongIoT objects developed by different manufacturers.

Lack of Support of the regulatory bodies, Government agencies and ubiquitous connectivity are barriers to device integration. Even quality and cost of receiving data from multiple sources are still with issues. Though, Applications like home monitoring systems, wearable devices along with consumer oriented products are the centre of attention of Internet of Things domain, Enterprise IT professionals are still with issues to apply these concepts from the context of generating business values. IoT Consortium conducted a research on the adoption of IoT during 2015.As per the study, there is a concern for Security and privacy. Though IoT is moving towards mass adoption, the manufacturers should provide cost effective, Intuitive and simple solutions for connected Home. ETSI has formed an internal M2M taskforce for M2Msystems and sensor networks. Objective of this taskforce is to develop and maintain end-to-end architecture, integration of sensor network, enhancement of security, quality of service and to strengthen interface of hardware devices. Similarly, IPv6, 6LoWPANs and ROLL networks are evolved for Standardization. CASAGARAS model is evolved for standards, regulations, and global coding systems of Radio Frequency Identification. The group is also putting effort in development of ubiquitous computing, Networks and usage of RFID network in socio economic components. This model is quite open and facilitates RFID to interface with physical world with ease. W3C model is facilitating coordination among machines, solves security and privacy issues and resolves different addressing schemes in Peer to Peer

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Networks. The network technologies like Wi-Fi, WI-MAX, Bluetooth, ZigBee, and Cellular Packet Radios are evolving rapidly. W3C is trying to mix these technologies for adding network effect. ANEC and BUEC models are concerned for openness, Interoperability, Trust, Security, safety, reliability, protection of fundamental rights and respect for European values.

iii. Role of Iot in Home Automation

The IoT based Home Automation will enable the user to use a Home Automation System based on Internet of Things (IoT). The modern homes are automated through the internet and the home appliances are controlled. The user commands over the internet will be obtained by the Wi-Fi modems. The Microcontroller has an interface with this modem. The system status is displayed through the LCD display, along with the system data. This is a typical IoT based Home Automation system, for controlling all your home appliances. The smart home market is taking off as IoT device prices come down and the general public comes to understand the benefits of these products. And from smart homes, the next logical step is smart cities, which would take the IoT to the next level. And yet, smart homes are just one small part of our daily lives that the Internet of Things will renovate in the coming years.

Fig. 7. Role of Iotin Home Automation

The beauty of the Home Automation system lies in the fact that the settings are manageable from your smart phones and other remote-control devices. Smart home IoT devices can help reduce costs and conserve energy. The Home Automation segment includes smart lighting, smart TVs and other appliances.

II.   APPLICATIONSAND TECHNOLOGIES

- Heating, ventilation and air conditioning (HVAC): it is possible to have remote control of all home energy monitors over the internet incorporating a simple and friendly user interface.
- Lighting control system: The term lighting control system refers to an intelligent networked system of devices related to lighting control. These devices may

include relays, occupancy sensors, photocells, light control switches or touch screens, and signals from other building systems

- Occupancy-aware control system: it is possible to sense the occupancy of the home using smart meters and environmental sensors like CO_2sensors, which can be integrated into the building automation system to trigger automatic responses for energy efficiency and building comfort applications.
- Appliance control and integration with the smart grid and a smart meter, taking advantage, for instance, of high solar panel output in the middle of the day to run washing machines.
- Security: a household security system integrated with a home automation system can provide additional services such as remote surveillance of security cameras over the Internet, or central locking of all perimeter doors and windows.
- Leak detection, smoke and CO detectors
- Indoor positioning systems
- Home automation for the elderly and disabled
- Pet Care, for example tracking the pet's movements and controlling access rights

III.   IMPLEMENTATION

In a review of home automation devices found two main concerns for consumers:

- A Wi-Fi network connected to the internet can be vulnerable to hacking.
- Technology is still in its infancy, and consumers could invest in a system that becomes abandon ware. In 2014, a search engine bought the company selling the Revolve Hub home automation system, integrated it with Nest and in 2016 shut down the servers Revolve Hub depended on, rendering the hardware useless.

In a research conducted in2011, by a famous company found, that home automation could involve high cost of ownership, inflexibility of interconnected devices, and poor manageability.
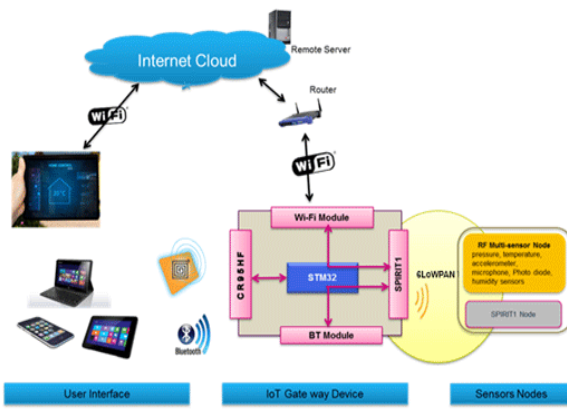
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Fig. 8. Applications works

Fig. 9. Percentage of IoTusers

A. List of home automation software

Home Automation software is software that facilitates control of common appliances found in a home, office, or sometimes a commercial setting, such as lights, HVAC equipment, access control, sprinklers, and other devices. Software typically provides for scheduling tasks, such as turning sprinklers on at the appropriate time, event handling, such as turning lights on when motion is detected. Typically the application will support multiple interfaces to the outside world, such as XMPP, email, Z-Wave, X10, etc. The software will typically provide a user interface which is often based on a client-server model, such as a web UI or a Smartphone app, or some combination thereof.

IV. CONCLUSION

Today in this century home and offices are equipped with various machineries. Besides, people have various devices for surfing in web. That's why we have introduced a system hatcanbeaccessedfromallsortsofdevicesanddatabasecanbeupdat edfromanywhere.Ifparticulardeviceworkson, the other means of devices will be easily operated. The database is developed such a way that can be accessed from any sort of device that supports internet. In this regard motion and vibration sensor is brought here because of its high quality sensing. The system is very easy to install. For this, just need HD spy camera connection for recording and for motion detection a motion sensor and vibration sensor, the ultrasonic range detector is to detect the distance of the object, temperature and humidity sensors to maintain the room temperature. Water level sensor to filling the overhead tank. These are controlled by arduino controller. Home Automation is definitely a resource which is capable of make a home setting automated. People can be in command of their electrical devices via these Home Automation devices and set up the controlling actions in the workstation. We think this device have high potential for marketing in the future.
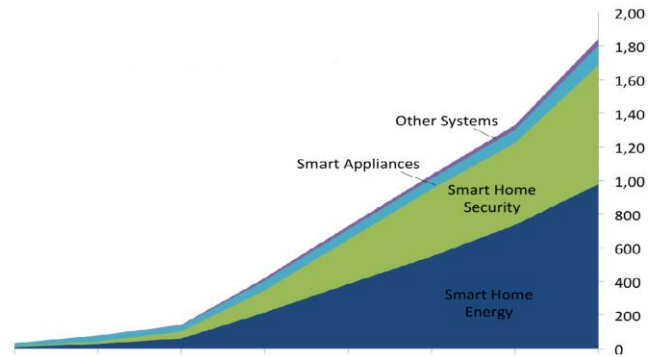
V. FUTURE SCOPE

In real time web based home automation system this project can be extended in future to ensure the high security, the motion and vibration can be monitored through online via HD spy camera. With this, the system can be assimilated in a whole building of any institution or residential building and can monitor from anywhere. This way, advantages of home automation can be more availed. At a laboratory, researchers are currently developing wireless applications to control lighting and home security devices. Wireless home entertainment devices are next on the agenda at some lab. Some laboratory is currently working on a way to make Wi-Fi reach farther and even work through walls. Basically, it will eliminate Wi-Fi cold spots. Purveyors of DSL and other home-broadband technologies likely will drive these smart-home applications, particularly as broadband companies compete to turn old homes into smart homes. When Things Start to Think, these kinds of home-networking technologies were a far cry from being mainstream. But now, to paraphrase Gershenfeld, computing has become more for people than for computers, even if your coffee pot doesn't have an IP address yet.

Fig. 10. Future scope

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