Review of Smart Homes - Current Features & Future Perspectives

Project Report

submitted by

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INDEX

1. ABSTRACT:

A smart home is an application of ubiquitous computing in which the home environment is monitored by ambient intelligence to provide context-aware services and facilitate remote home control. This review paper attempts at presenting an overview of previous smart home research as well as the associated technologies. A brief discussion on the building blocks of smart homes and their interrelationships is also presented. It describes collective information about sensors, multimedia devices, communication protocols, and systems, which are widely used in smart home implementation. Special algorithms from different fields and their significance are explained according to their scope of use in smart homes. We will be taking into consideration various everyday devices that could be used in an efficient way and to rightly put it in a “smart way”. A collection of such devices will help our generation to lead a better lifestyle that is not only much easier but also eco-friendly. This review paper also attempts to explore concrete guidelines for developing a practical and sustainable smart home.

2. PROBLEM STATEMENT

Home automation refers to the control of household appliances through the use of computer technology. Computer Systems allows remote control of lighting through complex microcontrollers or computer-based networks with several degrees of intelligence and automation. It provides security, energy efficiency and ease of use therefore, more is adopted. It also provides a remote interface to appliances to provide control and monitoring in a web browser.

- **OBJECTIVE:**

Until recently, automated central control of systems throughout the building has been found only on a large scale Commercial buildings and expensive houses. They generally only involve lighting, heating and cooling. Systems, building automation, rarely provide more than just control, monitoring and programming functions and was only accessible from specific control points within the building itself. With the arrival of "Internet of Things" in the last decade, we pushed for the ubiquitous computing in All the spheres of life. Therefore, it is extremely important to simplify human interaction with technology. Automation is an area that aims to achieve simplicity by increasing efficiency.

The goal of the automation system is to promote the cause of automation in order to achieve the goal of simplicity. Where home automation really becomes "smart" is in Internet-enabled devices that are connected to this Network and check it. The classic control unit is the home computer, for which many of the previous ones Home automation systems have been designed. Home automation systems today are more prone Distribute programming and monitoring control between a dedicated device at home, such as a security system control panel and an easy-to-use application interface that can be accessed via an Internet enabled for PC, smartphone or tablet. This paper aims to conduct a survey of all existing systems and compare those available Features. The document will also compare and

contrast all the systems and analyze their various characteristics and disadvantages.

A wide variety of options are available for home automation systems.

- **CHALLENGES & CONSTRAINTS:**

Reliability

For home automation to be successful, developers must address concerns about the reliability of smart devices compared to traditional household products and equipment. If the connected devices do not have similar functionality to the precursor products, they could create a new class of problems, such as how to guarantee the continuity of the service in case of an unexpected failure or service failure.

A large-scale outage is one thing, but a connected device or a home automation provider is also at the mercy of the consumer's broadband connection. If your product can not resort to a lower standard of useful functionality when an Internet connection is not available, the consumer's assessment of your product will be impaired every time your Internet connection has problems. This creates a large dependence on third parties for smart device companies.

Security

Before consumers trust intelligent home security systems, they must be assured that no malicious party can hack into their smart home systems, which could give thieves and vandals access to their data or even the physical capacity to enter their homes. With an increasing number of home automation devices, including microphones, cameras and other monitoring technologies, a compromised home automation configuration could allow cyber criminals to register families in the privacy of their homes. In addition, compromised IoT devices with weak security

or configuration processes that allow consumers to use devices with default passwords unchanged have recently been used as part of the huge Distributed Denial of Service (DDoS) attacks, programs that make servers are overwhelmed by overwhelming them with incoming data. Implementing robust security measures is essential for IoT providers if their products do not become a vector for espionage, blackmail, DDoS attacks or worse. Developers should consider solutions that force them to change the default passwords and implement end-to-end encryption between devices.

Collection and use of data

Many connected home and smart products are based on value propositions that are partly about new functions and partly about the more intelligent use of resources. To achieve this, data flows between devices and servers operated by device providers, between devices, and to and from the consumer's smartphone or computer. This creates opportunities to collect data that can be used to improve the service, or that vendors analyze to know the habits of consumers to build and grow existing relationships. Even if the systems are not hacked by malicious third parties, users and consumers must ensure that the suppliers that provide these products and services are reliable. Suppliers must see compliance with data protection laws as a value differentiator when developing their product offerings and marketing strategies. Suppliers that do not do so will gradually lose out in a market that is increasingly aware of data and privacy.

Digital transformation and integration

The evolving 'connected home' means that many related professions, such as locksmiths, heating engineers and electricians, should consider putting software at the center of their business and becoming digital providers to keep up with the market.

These professionals still represent key intermediaries for consumer choices about major installation projects. Providers who understand this and provide software

tools that can be implemented to interact with particular products are more likely to benefit from the goodwill generated in the professional community.

Responsibility

The solutions to the problems of smart devices often come in the form of updates and patches, which are not always completely reliable. Developers should also keep in mind that not all users will download updates as they become available, which will lead to a "delay of the release" as devices continue to run older software. In addition to creating support challenges for providers, this could leave devices vulnerable to attack. All this creates a complex situation from the perspective of product liability, since the device used at a given point can operate very differently from the device that the consumer bought for the first time.

3. RELATED WORKS

[1] F. Campana et al. Home Care (HC) has been considered as a fundamental component of a network of long-term care centers, capable of reducing institutionalization, expenses and the risk of death. The objective of an effective HC has the direct social implication of helping people who depend partially or totally to live in their environment as long as possible and to contrast the inappropriate use of institutionalization. It should be considered that patient care with HC (HCP) is particularly complex due to the growing number of people in such circumstances, due to the large amount of resources needed to ensure quality long-term care, and because the HCP is an elderly patient with concomitant diseases and conditions, cognitive and / or physical impairment, functional loss of multiple disabilities and diminished self-dependence.

[2] D. Vergados et al. In the current document, the most important aspects of the architecture of the INHOME project are presented to improve the quality of life of the elderly in the home, whose main objective is to improve the ways of providing intelligent services to help the independent life of the elderly. elderly people in the home. Healthcare organizations around the world are encouraged to find more efficient methods to provide high quality care with cost savings. Older people living alone may fear being unable to get help if they are injured or sick. For many families, the spectrum of such an event can dominate decisions about housing arrangements. During the last decades, this fear has generated an automated marketing industry, alarm and notification systems, as well as assistive technologies and interventions that aim at an easier and efficient control of the living environment, as well as the provision of specialized homes.

[3] G. Dewsbury and M. Edge et al. This paper considers the role of smart home technology in relation to the current principles of housing design within the field of health and well-being. The concepts of "life-long homes" and universal design

without barriers are considered, and the construction and community care regulations of the United Kingdom are investigated in relation to the design process. It is argued that the current role of assistive technology in relation to people with disabilities and the elderly can be developed through the use of intelligent technology for the home and that the concept of home design should extend beyond the physical approach of " bricks and cement "Account of the rapid advances in information technology and control.

[4] D. J. Cook and S. K. Das et al. In this article we analyze the state of the art in the investigation of intelligent environments. The survey is motivated by the recent dramatic increase in activity in the field and summarizes work in a variety of support disciplines. We also discuss the application of intelligent environments research to monitoring and health care, followed by ongoing challenges for ongoing research.

[5] A.-H. Bayer et al. As Americans get older they want to stay in their own homes, and many say they are modifying their residences so that they can do so. More than 8 out of 10 respondents aged 45 and over (including many Baby Boomers), and more than 9 out of 10 of those 65 and older, say they would like to stay where they are for as long as possible. Even if they needed help to take care of themselves, 82% would prefer not to move out of their current homes. The nationwide telephone survey of 2,000 middle-aged and older Americans, conducted between November and December 1999, also found that 70% of those who can make changes have made at least one modification to make their homes easier to live, 85% have made simple changes to their homes and 67% of those who make changes or modifications to their homes believe that doing so will allow them to live there longer than they could have, most of them for another 10 years or more.

[6] R. Shafer et al. The worries about the aging of America seem exaggerated. Although the population of 65 years and older will grow dramatically after 2010, the balance between working-age adults and the dependent population will not exceed its historical maximum. In addition, with their better health and better education, the

older adults of the future will probably continue to work well beyond the traditional retirement age, further reducing the ranks of the dependent population. Undoubtedly, the impending growth in the number of older adults will add to the pressures on federal income support and health insurance programs. The wide disparity in wealth among baby boomers will remain well in their retirement years, leaving many low-income seniors with few options for accommodation and special attention. Older tenants will face particularly burdensome housing costs. However, for home developers, remodelers and service providers, older adults represent a large and growing market. With their greater wealth and more active lifestyles, it is likely that more seniors have second homes, make modifications to their residences to adapt to changing needs and choose specialized environments, such as active retirement communities, congregate housing and assisted living facilities. . And since older adults overwhelmingly prefer to "age in place," the home service market is ready for a boom.

[7] S. S. Intille et al. Ubiquitous computing researchers are increasingly turning to "living laboratories" with sensors for the study of people and technologies in more natural environments than a typical laboratory. We describe the design and operation of PlaceLab, a new laboratory for the study of ubiquitous technologies in domestic environments. Volunteer participants in the research live individually in the PlaceLab for days or weeks at a time, treating it as a temporary home. Meanwhile, the detection devices integrated into the fabric of the architecture record a detailed description of their activities. The installation generates sensors and observational data sets that can be used for research in ubiquitous computing and other fields where domestic contexts impact behavior. We describe some of our experiences in the construction and operation of the living laboratory, and we detail a recently generated sample data set, available online for researchers.

4. PROPOSED SYSTEM

- **INTRODUCTION**

Smart Home is the collaboration of technology and services through a network for a better quality life. A smart home allows the whole house to be automated and, therefore, provides ease and comfort for daily activities in the home. This technology is used to make all electronic devices act intelligently. In the near future, almost all electronic devices will take advantage of this technology through home networks and the Internet. Many people think that this technology is pure network. Others think that this technology will reduce their workload, but smart home technology is a combination of both and much more. Smart home technology is currently being implemented throughout the home, especially in the kitchen and living room. Basically, the smart home provides users with the features of safety, comfortable living and energy management, as well as additional benefits for people with disabilities.

This technology may sound new but only uses existing technologies. An intelligent device is a common device with a much more complex computer installed to give it more functionality. These functions are what make it so different. Broadband cable, DSL, Bluetooth and wireless technologies provide a way to have a home network for devices to communicate with each other, as well as over the Internet. These technologies, whether wired or wireless, provide a foundation upon which the smart home will operate.

Research standards have already anticipated an intelligent and connected home where multiple devices cooperate to pamper the wishes of users with little or no effort. For example, in a home with remotely controllable lights, cameras, and padlocks, it should be easy to automatically alter the lights based on weather and time of day, as well as see remotely who is at the door before unlocking it. But these simple tasks at home are not available in the mainstream despite the fact that the necessary hardware devices (such as wireless light switches, door locks and cameras) are reasonably priced. Many analysts predict that the smart home of the future is likely to contain between 15 and 30 connected devices and sensors, all connected through a home network and connected to the Internet. The collective

income generated by the home automation and home energy management (HEM) segments will have a value of more than $ 44 billion in 2016, according to the prediction made by market analysts ABI and Berg Insight. However, the full possible income of the smart home will be a little higher since the devices of the entertainment, health and home security sectors will also be connected.

The complete vision of smart home services will be carried out in progressive stages. Currently, integrated connectivity is a novelty in some high-end home devices. At some point in the future, connectivity will be widespread and a feature of virtually all home devices. Smart home services will go through at least three different stages of market evolution, as illustrated below:

Stage 1 - Independent connected devices

The main characteristics of this stage include:

Connecting several independent devices to the back-end systems of the service provider and the Internet.

A separate control function and interface for different devices.

Stage 2 - Service connected silos

The main characteristics of this stage include:

Device connectivity and data management through dedicated control centers, separated for each vertical.

A relatively sophisticated range of service capabilities due to data exchange and limited point-to-point connectivity between devices.

At this stage, a wide variety of devices, including entertainment, power management, security, health and wellness, at home will include a certain level of IT capacity designed to support smart services. Some of these devices will have complementary functions, which justifies the convergence of services for the smart home. As they use an increasing number of connected services, consumers will value being able to use a single "My Home" place to see the performance and control of their home devices. Closer integration will also potentially allow for improved functionality.

Stage 3 - Integrated smart home

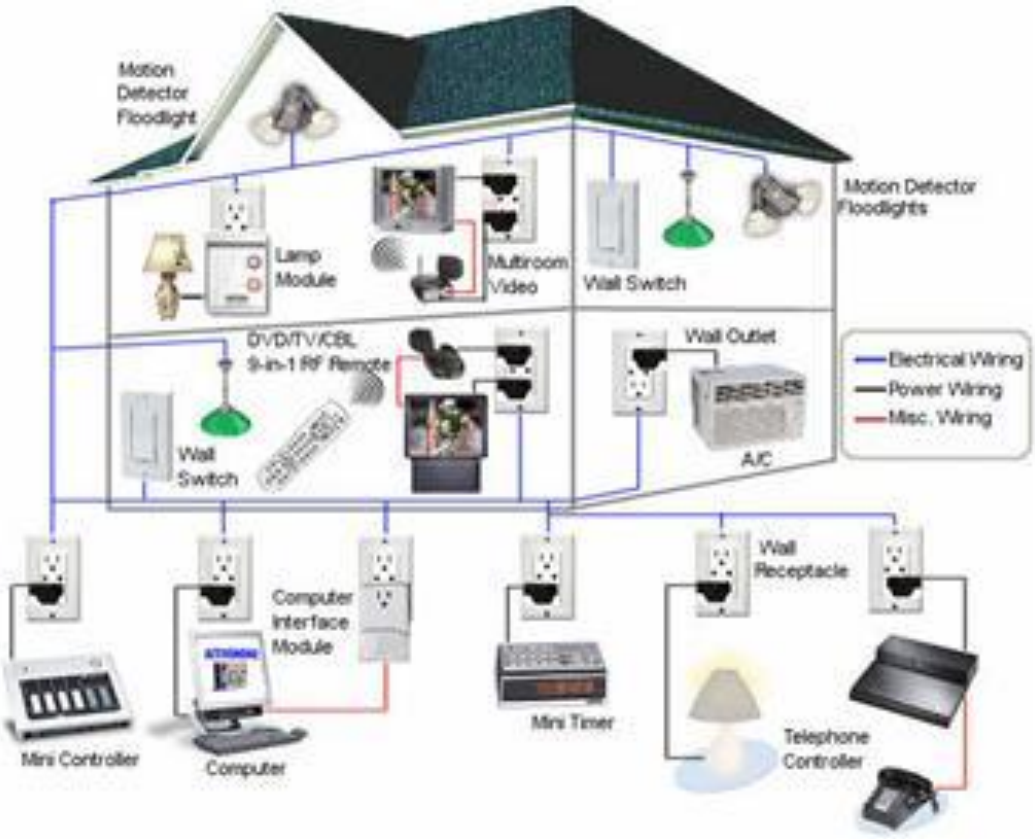
The main characteristics of this stage:

Exchange of data between different devices and smart home systems.

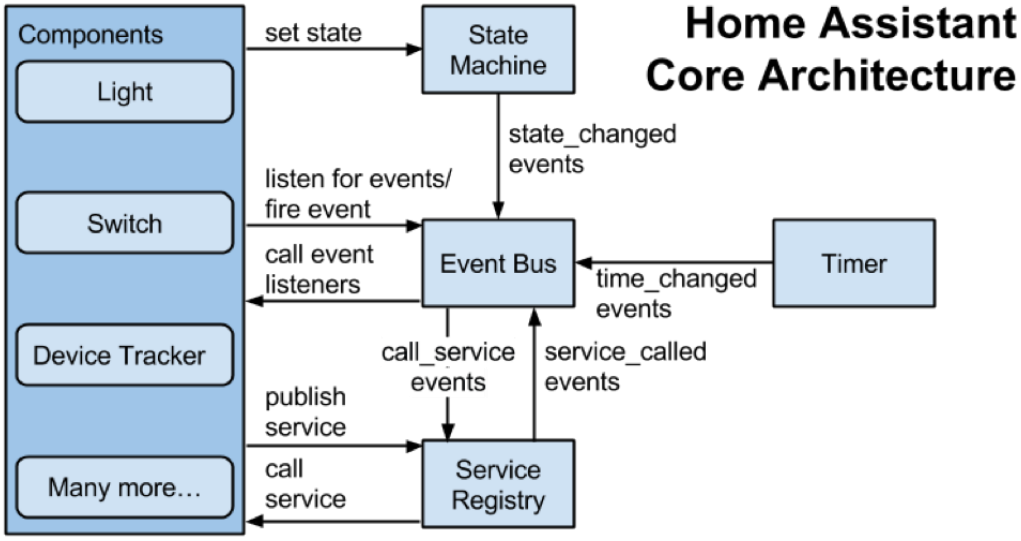
Existence of a single access door for the home enabled for mobile devices or an integration point as a platform to support different applications for the smart home.

The key feature of this stage is the creation of an environment where data from different application areas can be integrated to provide a richer set of services for the smart home. These can be application-oriented services, such as comprehensive energy management. They can also be support services, as a central point of control to define security policies and access control in multiple devices related to the home.

- **CONCEPTUAL MODEL**



- **SOFTWARE ARCHITECTURE**



- **SOFTWARE REQUIREMENTS & HARDWARE REQUIREMENTS**

1. **Internal network** – wire, cable, wireless
2. **Intelligent control** – gateway to manage the featured systems
3. **Home automation** – products within the home and links to services and systems outside the home.

Intertek omits home intelligence and places more emphasis on remote access. A recent definition by Satpathy provides a more appropriate concept of smart homes. According to Satpathy, A home which is smart enough to assist the inhabitants to live independently and comfortably with the help of technology is termed as smart home. In a smart home all the mechanical and digital devices are interconnected to form a network, which can communicate with each other and with the user to create an interactive space. Considering the current trends in smart home research, we can define the smart home as an application of ubiquitous computing that is able to provide user context-aware automated or assistive services in the form of ambient intelligence, remote home control or home automation.

An extensive study by forsa (2010) conducted on behalf of the Verbraucherzentrale Bundesverband e.V., the leading consumer association in Germany, analyzed the perceptions and evaluations of smart metering in Germany. An initial focus group study showed that consumers' knowledge of smart metering is low. For example, none of the focus group participants had heard of the English expression "smart meter"—which is often used by German energy experts. In a follow-up survey using a sample of $n > 1{,}000$ participants only 3% knew the real meaning of the term. The German terms intelligenter or neuer (**=new**) meter were slightly more familiar in both studies, but still a vast majority had not heard of them. After a short explanation of the concept of smart metering, there were positive initial reactions from participants of both the focus group and the survey. Participants in both studies saw the advantage of having the chance to reduce spending on electricity and exercise a greater control of costs;

however, there were also strong doubts about the real potential for conserving electricity and saving costs as well as major concerns about the necessary investments and possible misuse of data.

5. Devices & Equipments: Smart homes rely on data acquisition equipment and devices to assess the states of residents and their environments. These monitoring devices can be classified into three categories: sensors, physiological devices, and multimedia devices. Sensors are used to measure environmental parameters. Physiological devices monitor health conditions and vital signs. Multimedia devices capture audiovisual information and provide an interface between the system and the user. Table-I describes the taxonomy of home and user monitoring equipment and devices.

Category	Name	Purpose
Sensor	Light	Measure intensity of light
	PIR	Identify user location
	Temperature	Measure room/body temperature
	Pressure	Identify inhabitant location
	Power	Calculate power usage
	RFID	Object and people identification
	Switch sensor	Door open or close status detection
	Ultrasonic	Location tracking
Physiological device	ECG	Pulse rate and variability
	PPG	Pulse rate and blood velocity
	Spirometer	Respiration rate, peak flow
	Colorimeter	Pallor, throat inflammation
	Sphygmomanometer	Blood-pressure measurement
	Weight	Measure patient weight

	Pulse meter	Monitor heart rate
Multimedia device	Camera	Monitoring and tracking
	Microphone	Voice command
	Speaker/Headset	Announce alert and information
	Display	Show visual information

Table-1: Category and purpose of smart home monitoring devices

To enrich intelligent systems, smart homes must be provided with sufficient information from sensors, cameras, microphones, and other interfacing devices. Sensory information is prone to noise that misguides the information-processing system with wrong input signals. There should be additional methods to improve the accuracy of detection of sensor networks. Image-processing systems require extra hardware resources and relatively long times to detect and reorganize residents.

6. HVAC Systems: HVAC stands for Heating, Ventilating, and Air Conditioning. The system is used to provide heating and cooling services to buildings. HVAC systems have become the required industry standard for construction of new buildings.

HVAC systems are the major energy consumers in buildings. Operation and control of HVAC systems have significant impacts on the energy or cost efficiency of buildings besides their designs. Buildings nowadays are mostly equipped with comprehensive building automation systems (BASs) and building energy management control systems (EMCSs) that allow the possibility of enhancing and optimizing the operation and control of HVAC systems. Supervisory and optimal control, which addresses the energy or cost-efficient control of HVAC systems while providing the desired indoor comfort and healthy environment under the dynamic working conditions, is attracting more attention of the building professionals and the society and provides incentives to make more efforts in developing more extensive and robust control methods for HVAC systems.

6.1 Background: The continuous increase in the global electricity consumption is constantly demanding energy saving strategies. The energy consumption of the Heating, Ventilating, and Air-Conditioning (HVAC) systems is about 50-70% of the building energy usage for maintenance of thermal comfort in buildings [1]. The operation of chillers and cooling towers leads to the peak electricity demand and accounts for about half of electricity consumption for air conditioning [2]. The energy consumption of an HVAC system depends not only on its performance and operational parameters, but also on the characteristics of the heating and cooling demand and thermodynamic behavior of the building. The most important factors that contribute to HVAC energy usage reduction is via proper control of the building heating and cooling demand.

Integrated control of the building cooling load components such as solar radiation, lighting and required fresh air can result in significant energy savings of a cooling plant. Energy end-use in non-domestic buildings is usually grouped in following categories:

1. Energy used for building heating, ventilating and air-conditioning which is consumed by building HVAC equipment

2. Energy used for domestic hot water provided either by building heating source or by dedicated domestic hot water heaters

3. Energy used for lighting consumed by lights

4. Energy used by different appliances that can be anything from desk top computers over vending machines to hand dryers in toilets

Type	**Capacity [kW]**	**COP**	**IPLV**
Air-Cooled with Condenser	< 528	2.80	3.05
	≥ 528	2.80	3.05
Air-Cooled without Condenser	All	3.10	3.45
Water-cooled, Reciprocating	All	4.20	5.05

Water-cooled, Rotary Screw, Scroll	< 528	4.45	5.20
	≥ 528 & ≤ 1055	4.90	5.60
	> 1055	5.50	6.15
Water-cooled, Centrifugal	< 528	5.00	5.25
	≥ 528 & ≤ 1055	5.55	5.90
	> 1055	6.10	6.40

Table-2: Minimum COP and IPLV of Packaged Water Chilling Packages (Performance Standard for Rating Packaged Water Chillers)

The usual way of presenting the energy efficiency of chillers is by the coefficient of performance (**COP**) and integrated part load value (**IPLV**)

Coefficient of Performance: The coefficient of performance (or COP) of a heat pump, refrigerator or air conditioning system is a ratio of useful heating or cooling provided to work required. Higher COPs equate to lower operating costs.

Integrated Part Load Value: The Integrated Part Load Value (IPLV) is a performance characteristic developed by the Air-Conditioning, Heating and Refrigeration Institute (**AHRI**). It is most commonly used to describe the performance of a chiller capable of capacity modulation.

In order to understand non-domestic building energy consumption contributing to energy end use categories and their subsequent carbon emissions, it is necessary to have information about the HVAC equipment and appliances used in buildings, together with the way they are used, as well as the building characteristics.

Boiler/System		**Efficiency (%)**
Condensing Boilers		
1.	Under-floor or warm water system	90

2.	Standard size radiators, variable temperature circuit	87
3.	Standard fixed temperature emitters (83/72 ^{O}C)	85
Non-Condensing Boilers		
1.	Modern high-efficiency non-condensing boilers	80-82
2.	Typical good existing boiler	70
3.	Typical existing oversized boiler (atmospheric)	45-65

Table-3: Typical seasonal efficiencies for various boiler types

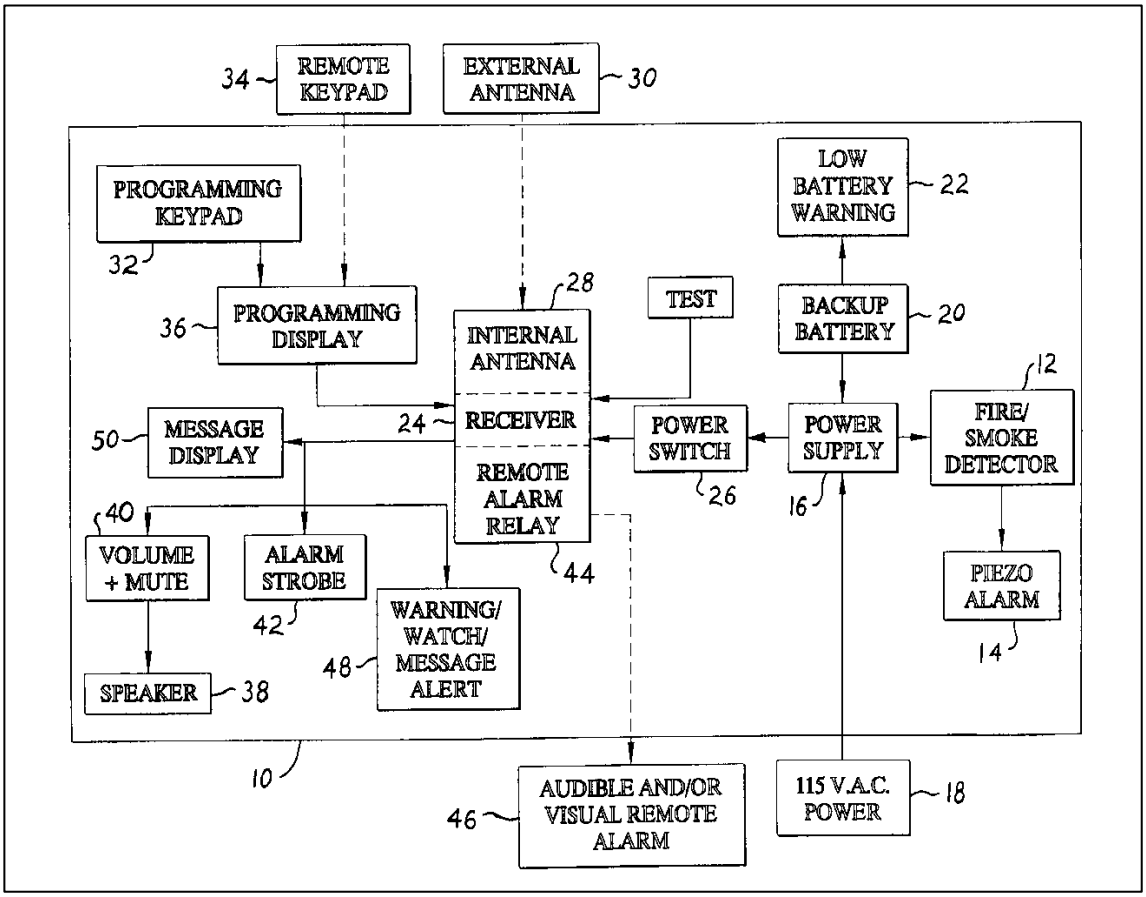
7. Multiple Alert Smoke Detector: The battery powered smoke detector of the present invention is designed to provide an early warning of the presence of an environmental condition of fire or smoke to persons in remote areas of a building with respect to the location of the environmental condition. The smoke detector sensing the environmental condition emits an audible alarm of continuous tone, while emitting a frequency modulated radio signal directly to other like smoke detectors to activate their alarms in a manner indicative of the location of the smoke detector sensing the environmental alarm condition. The device provides a single, central warning source for sudden emergency situations as well.

7.1 Preferred Embodiment: The present invention comprises a combination smoke detector and severe weather warning device, with all internal components being contained within a common housing. It will be seen that the housing may have any appearance or configuration as desired, so long as appropriate conventional apertures, openings, and/or passages are provided for access to such internal components as function controls, battery access for replacement, connections for external or remote components, etc. as desired.

The housing includes a smoke and/or fire detector, which activates an alarm when smoke and/or fire is detected. The detector may be an ionized particle detector for detecting smoke, a heat sensing device serving as a fire detector, or a combination of smoke and fire detecting instruments or devices, as desired. The alarm is preferably an economical

piezoelectric unit serving to emit a single audible tone. However, the detector may also activate other types of alarms, such as a visual alarm (strobe or other light, etc.) as desired.

The smoke and/or fire detector receives continuous electrical power from a power supply, also enclosed within the housing. The power supply in turn receives electrical power from a conventional external electrical power source, which provides nominal 115 volt alternating electrical current for the power supply, which reduces the voltage and rectifies the current to provide a relatively lower voltage direct current supply. An alternative power supply comprising a backup electrical cell or battery is also provided, with the system automatically switching from the external power source to the backup battery in the event of an external power interruption. A low battery power warning translates into an intermittent audible and/or visual warning, may be provided to alert a user that the backup battery is in need of replacement. It will be seen that a rechargeable electrical cell or battery may be provided, with additional circuitry provided for maintaining the electrical charge of the battery so long as external electrical power is supplied.



8. Medical Technology in Smart Homes: Prolonged life expectancy and increasing survival of acute diseases contribute to a growing number of elderly people at risk of institutionalization. But long-term institutionalization is not only a big financial burden to the healthcare system and therefore hard to maintain in the coming years, it is also not the preferred choice of many aging people. While older people are obviously in need of extended long-term care, they also wish to maintain their independence as long as possible. Studies show that many older people regard their home as a sanctuary and therefore prefer to stay at home, even at an increased risk to their health and safety. This wish is often related to a perceived increase in the quality of life in a familiar environment. Generally, quality of life is a quite complex concept referring to the individual perception of one's physical health, psychological state, level of independence, social relationships, personal beliefs and relationship to salient features in the

environment. But as people age, their perceived quality of life is mostly determined by their ability to maintain an autonomous and independent life [6].

While extended family structures traditionally provide internal support features for elderly family members, the analytic concept of extended families has largely diminished in recent years [10]. The profound social changes affecting the composition of families become especially evident in the growing number of elderly persons living alone. Already today, a high number of older or chronically ill people live on their own, without support by their families [12]. Over the last decades, the number of single households increased considerably, especially in the group of elderly people, and this trend is expected to continue in the coming years.

8.1 Video-based Homecare Solutions: Decreasing both the costs of healthcare services and also the load of medical practitioners requires a dramatic change in the way future healthcare services are provided [14]. A variety of medical experts [1] argue that institutionalization in senior homes is unnecessary (and even counterproductive) and promote homecare as a fundamental component of a future network of long-term care facilities. Recent developments in information and communication technology lay the groundwork for new patient-centered homecare solutions. While the majority of computer-supported healthcare tools designed in the last decades focused mainly on medical caregivers, this trend recently changed with the introduction of assistive technology for providing supportive and adaptive services to ill or disabled individuals [15]. Several authors, e.g. [1] or [16] even expect the next generation of healthcare systems to be mainly based on the homecare idea, thereby extending healthcare from the traditional hospital setting to the patient's home.

In order to collect comprehensive opinions and to reflect them across a broader sample of women and men of different ages, the following data were taken into consideration.

I. Demographic Data: The first set of information included demographic data. Also, the users' previous experiences with different types of information and communication technologies (computer, internet, mobile, digital camera) were assessed.

II. In section two, opinions about the general suitability of video-based systems, implemented in home environments in order to monitor the health states of users, were taken into consideration.

III. In the third section, the importance of privacy was addressed.

IV. The fourth section addressed questions about feelings of trust.

V. The fifth section dealt with discretion of technology/avoidance of stigmatization

A first analysis addresses the general suitability of video-based systems, followed by the description of outcomes regarding perceived privacy and trust in these systems. Finally, the opinions regarding the discretion of technical systems and the avoidance of stigmatizing are described.

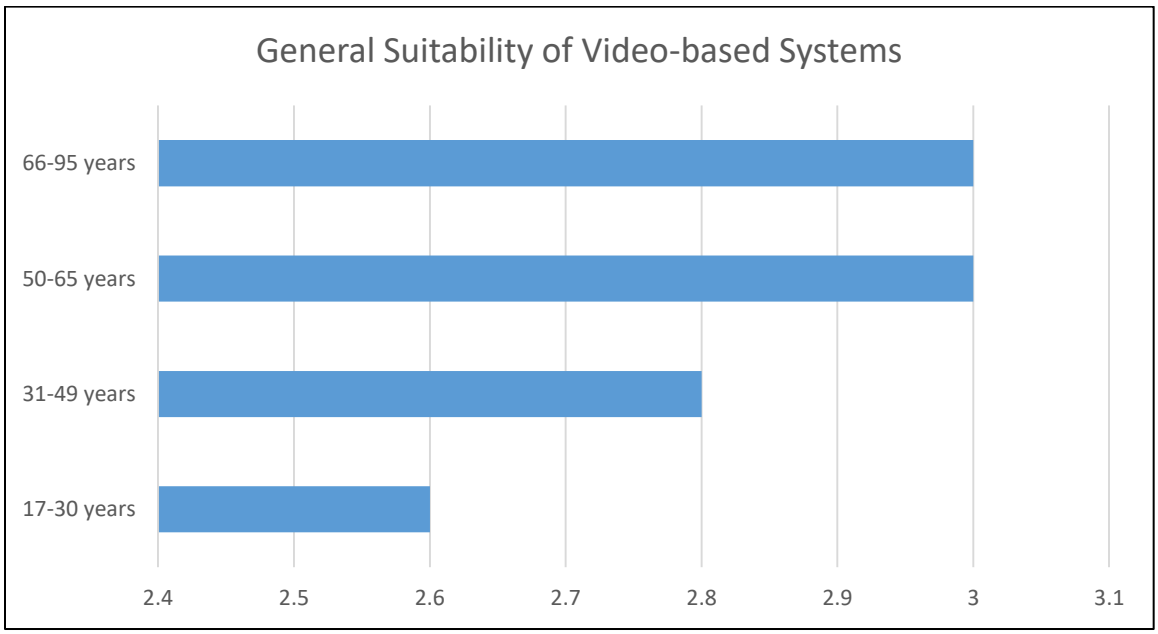


Figure-1: Would you be willing to let medical personnel monitor your home? (no = 0, probably not = 1, probably = 2, yes = 3), N = 165

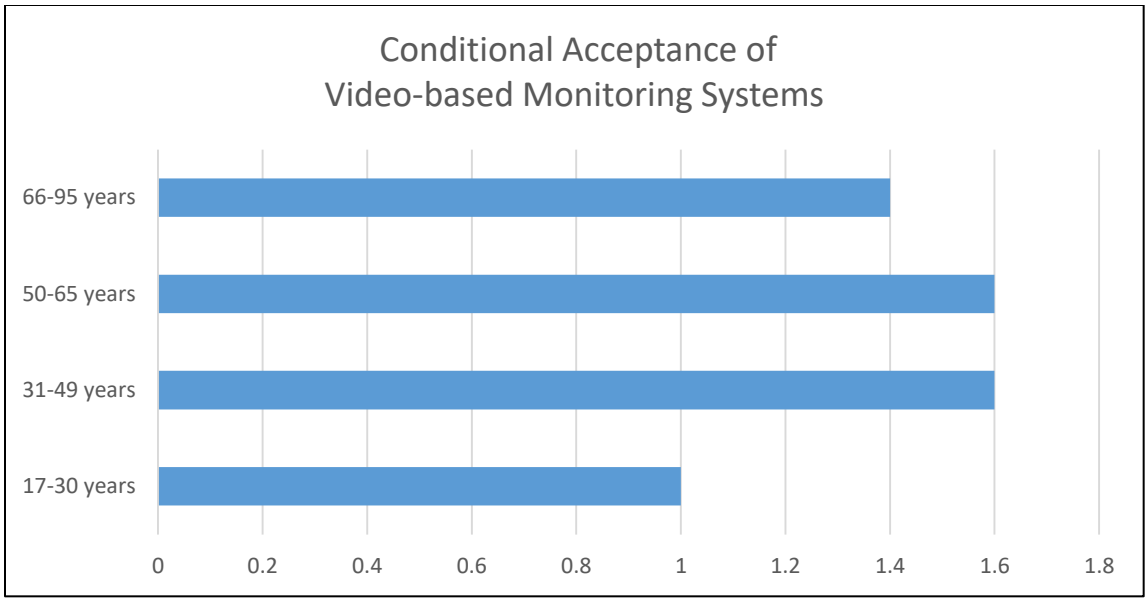


Figure-2: The thought of ubiquitous medical support worries me, but I would accept it, if it could really help me (no = 0, probably not = 1, probably = 2, yes = 3), N = 165

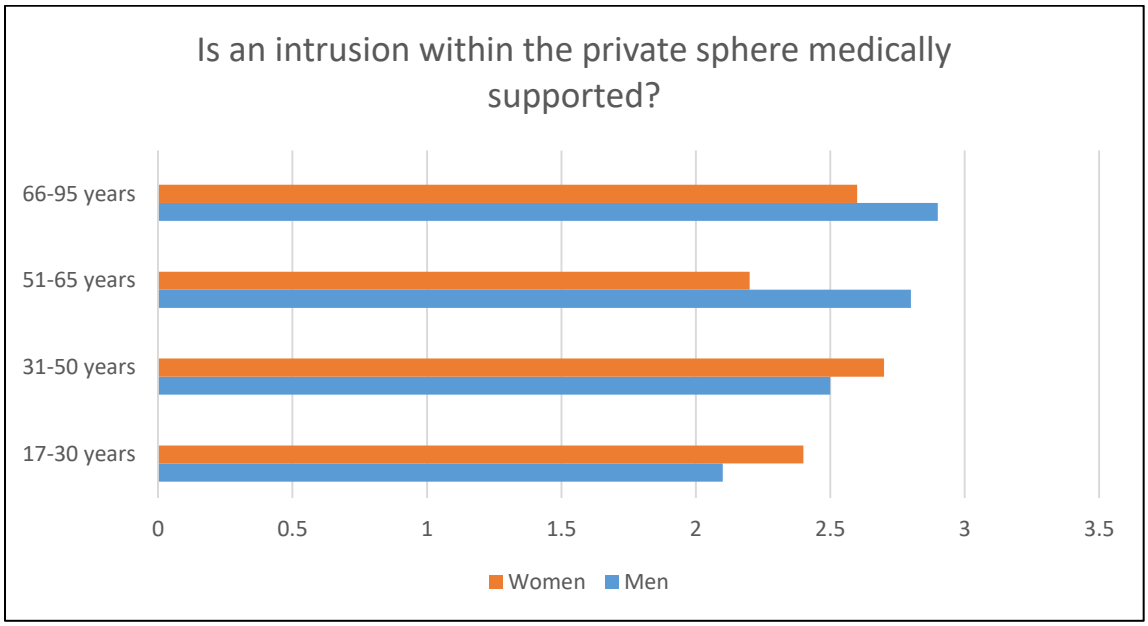


Figure-3: In order to get medical support, I would accept an intrusion in my personal privacy (no = 0, probably not = 1, probably = 2, yes = 3). Orange bars represent female, blue bars male respondents. N = 165

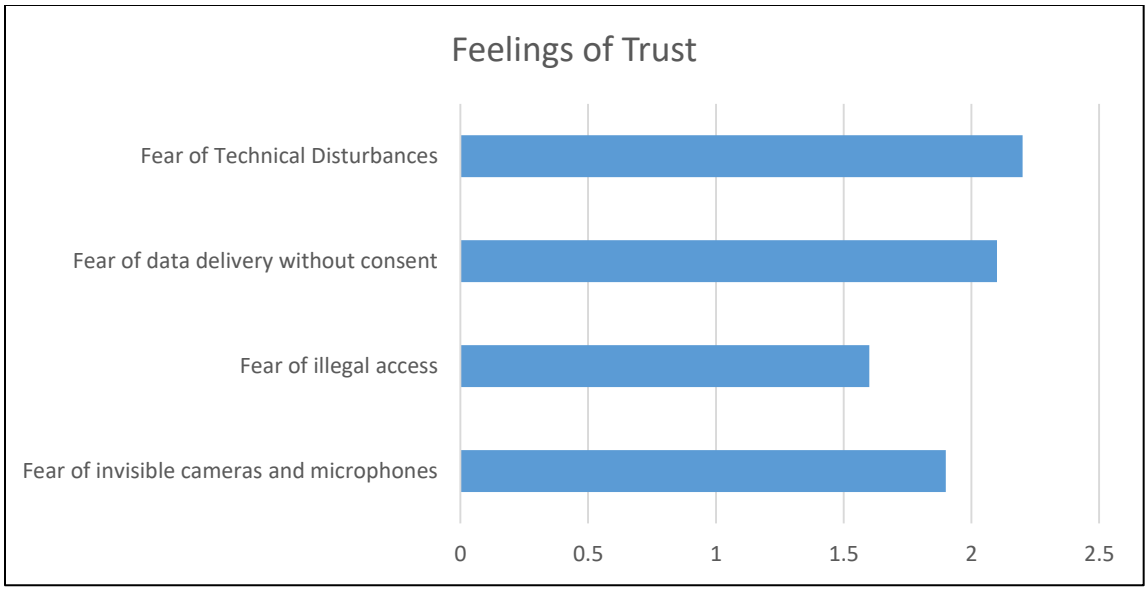
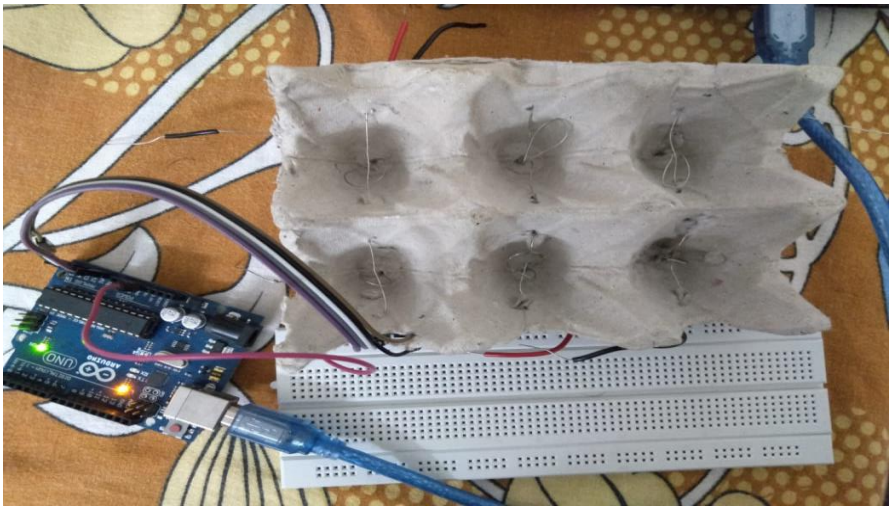


Figure-4: Descriptive outcomes regarding the reported fear different aspects of technology (1 = very strong; 4 = very low). N = 165

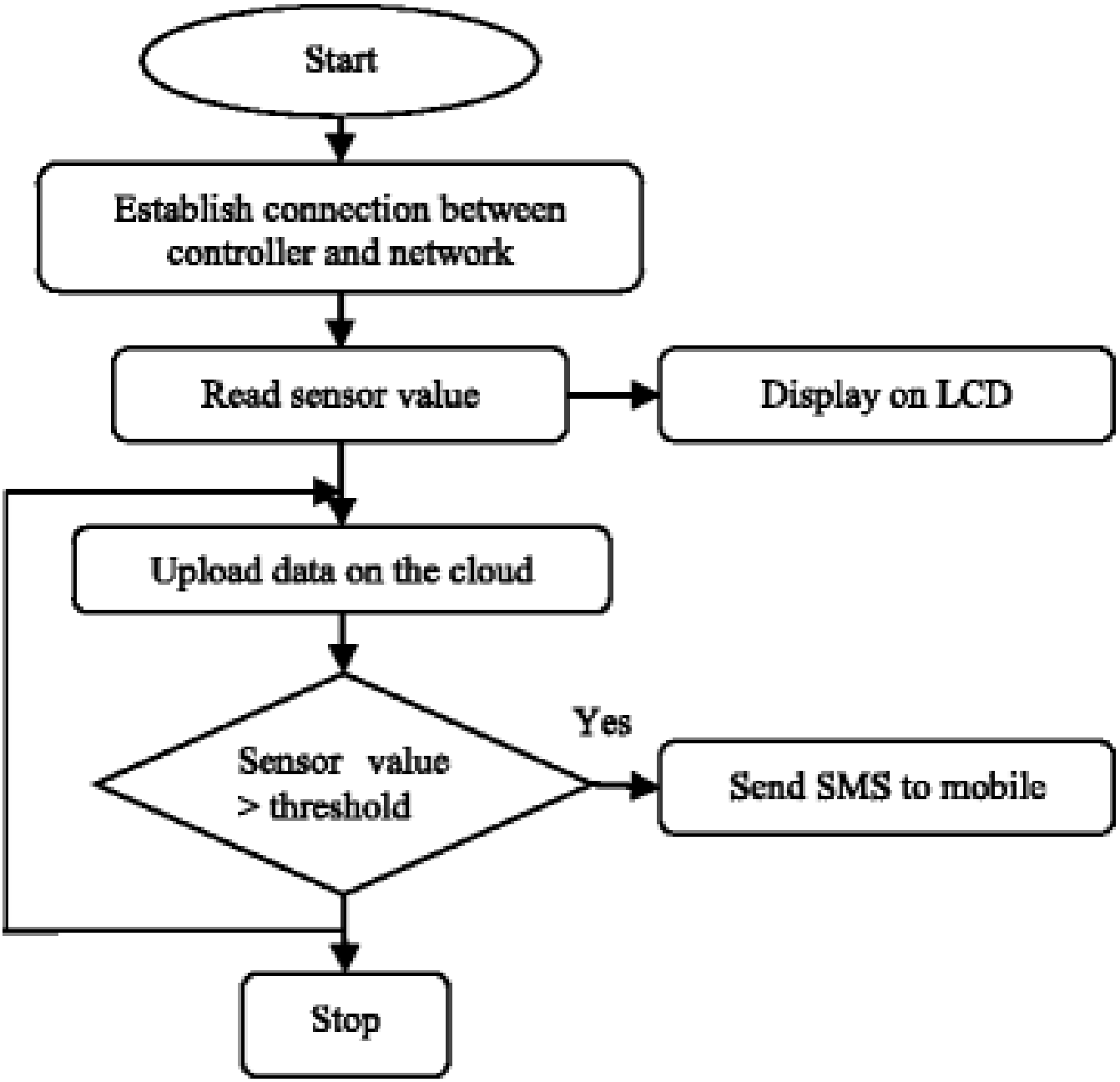
- **IMPLEMENTATION**

We created a model to continuously monitor the number of eggs in the refrigerator. The data is sent to the customer via the SMS and it can also be monitored on the Website.

The data is sent to the ThingSpeak cloud and Twilio is used to establish connections with the mobile phone of the customer via an SMS.



- **FLOWCHART**


Start
Establish connection between controller and network
Read sensor value
Display on LCD
Upload data on the cloud
Sensor value > threshold
Yes
Send SMS to mobile
Stop

- **CODE**

Python Script:

```
import httplib2

import serial

import requests

import time


from twilio.rest import Client

#account = "AC87b15bfd3a62ff7b07fe498901d9e07a"

account = "AC297f2b4bd856a022f689ae068b3eb076"

#token = "4a8347e2f1cd1f18b8db8fbfd32cfc29"

token = "7782cb5733eb06b71ff3d44b8e9970be"


client = Client(account, token)


ser=serial.Serial('COM4',9600,timeout=2)

print("Hello")

while (True):

    ch="
```

```
    while(ch==''):
        ch=ser.readline().strip().decode('utf-8')
    ch=int(ch)
    print(ch)
    print("got")

t1=requests.get("https://api.thingspeak.com/update?api_key=Q5EBGVB2SO0UMXGF&field1=%s"%(ch))
    print(t1)    # r=str(ch).split('$')
    if(ch<=3):
        msg=""
        msg="The Eggs are les than the limit"
        if msg!="":
            print("---->>>message")
            print(client.messages.create(to="+919585999720",
from_="+19522346819",body=msg))
        #54FY4DRVHN2S6GZJ
        print(t1)
        print("Uploaded")
```

Arduino Code:

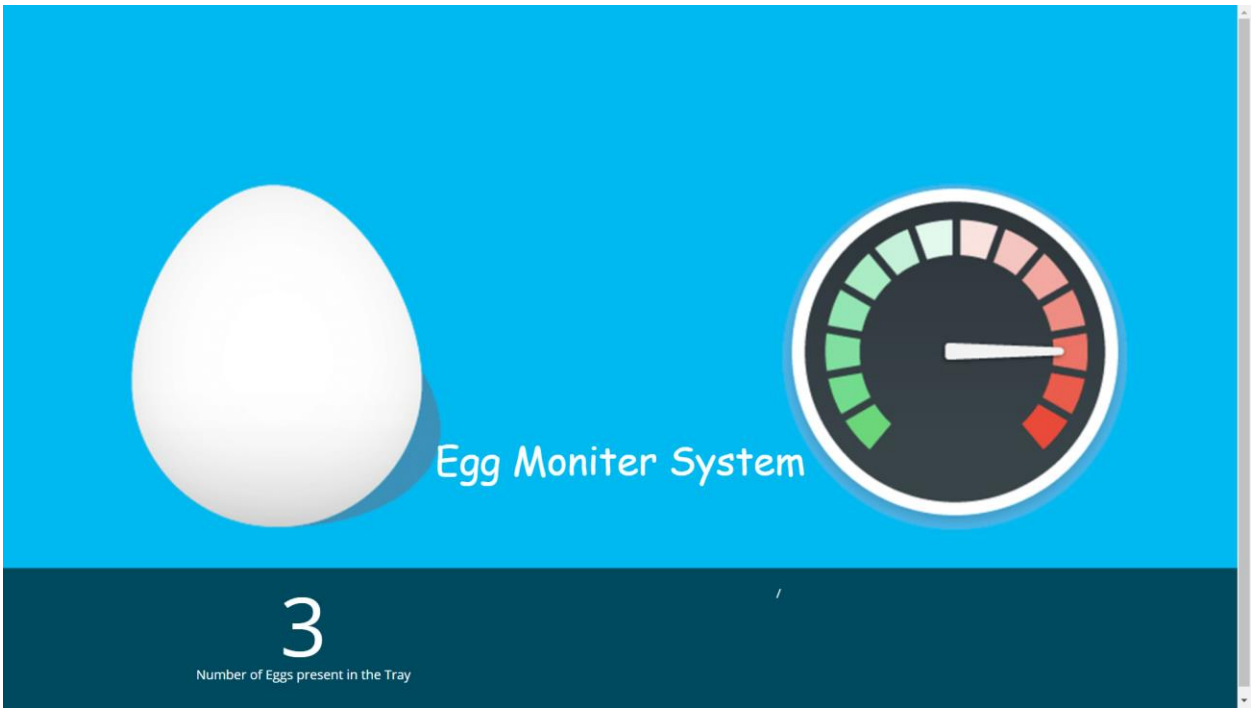
```
void setup() {
  // put your setup code here, to run once:
Serial.begin(9600);
}

int count, x1, x2,x3,x4,x5,x6, check=0;

void loop() {
  delay(1000);
  // put your main code here, to run repeatedly:
  count=0;
  x1=0;
  x2=0;
  x3=0;
  x4=0;
  x5=0;
  x6=0;
x1=analogRead(A0);
x2=analogRead(A1);
```

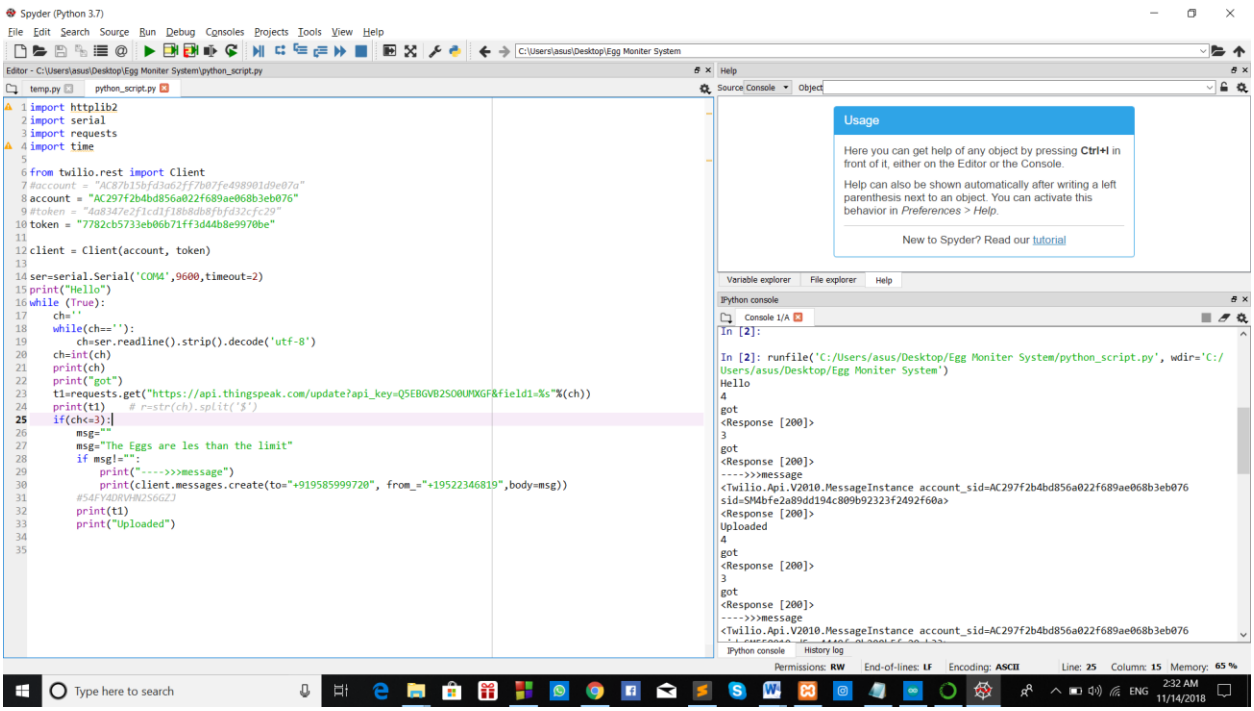
```
x3=analogRead(A2);
x4=analogRead(A3);
x5=analogRead(A4);
x6=analogRead(A5);

if(x1>1000){
  x1 = 1;
}
else
{
  x1=0;
}
if(x2>1000){
  x2 = 1;
}
else
{
  x2=0;
}
```

```
if(x3>1000){
  x3 = 1;
}
else
{
  x3=0;
}
if(x4>1000){
  x4 = 1;
}
else
{
  x4=0;
}
if(x5>1000){
  x5 = 1;
}
else
{
  x5=0;
```

```
}
if(x6>1000){
  x6 = 1;
}
else
{
  x6=0;
}
count = x1+x2+x3+x4+x5+x6;
if(count!=check)
{
  Serial.println(count);
  Serial.print(" ");
  check=count;
}
}
```

- **RESULT**


Egg Moniter System
3
Number of Eggs present in the Tray


Spyder (Python 3.7)
File Edit Search Source Run Debug Consoles Projects Tools View Help
C:\Users\asus\Desktop\Egg Moniter System
Editor - C:\Users\asus\Desktop\Egg Moniter System\python_script.py
temp.py
python_script.py
import httplib2
import serial
import requests
import time
from twilio.rest import Client
#account = "AC87b15bfd3a62ff7b07fe498901d9e07a"
account = "AC297f2b4bd856a022f689ae068b3eb076"
#token = "4a8347e2f1cd1f18b8db8fbfd32cfc29"
token = "7782cb5733eb06b71ff3d44b8e9970be"
client = Client(account, token)
ser=serial.Serial('COM4',9600,timeout=2)
print("Hello")
while (True):
ch=''
while(ch==''):
ch=ser.readline().strip().decode('utf-8')
ch=int(ch)
print(ch)
print("got")
t1=requests.get("https://api.thingspeak.com/update?api_key=Q5EBGVB2SO0UMXGF&field1=%s"%(ch))
print(t1) # r=str(ch).split('$')
if(ch<=3):
msg=""
msg="The Eggs are les than the limit"
if msg!="":
print("---->>>message")
print(client.messages.create(to="+919585999720", from_="+19522346819",body=msg))
#54FY4DRVMN2S6GZJ
print(t1)
print("Uploaded")
Help
Source Console
Object
Usage
Here you can get help of any object by pressing Ctrl+I in front of it, either on the Editor or the Console.
Help can also be shown automatically after writing a left parenthesis next to an object. You can activate this behavior in Preferences > Help.
New to Spyder? Read our tutorial
Variable explorer
File explorer
Help
IPython console
Console 1/A
In [2]:
In [2]: runfile('C:/Users/asus/Desktop/Egg Moniter System/python_script.py', wdir='C:/Users/asus/Desktop/Egg Moniter System')
Hello
4
got
<Response [200]>
3
got
<Response [200]>
---->>>message
<Twilio.Api.V2010.MessageInstance account_sid=AC297f2b4bd856a022f689ae068b3eb076 sid=SM4bfe2a89dd194c809b92323f2492f60a>
<Response [200]>
Uploaded
4
got
<Response [200]>
3
got
<Response [200]>
---->>>message
<Twilio.Api.V2010.MessageInstance account_sid=AC297f2b4bd856a022f689ae068b3eb076
IPython console
History log
Permissions: RW
End-of-lines: LF
Encoding: ASCII
Line: 25
Column: 15
Memory: 65 %
Type here to search
ENG
2:32 AM
11/14/2018

5. RESULT ANALYSIS

- TEST CASES

The model will estimate the number of eggs in the refrigerator. When the number of eggs in the refrigerator tray is less than 4, the same will be notified to the user.

i) No_of_eggs>=4

Result:

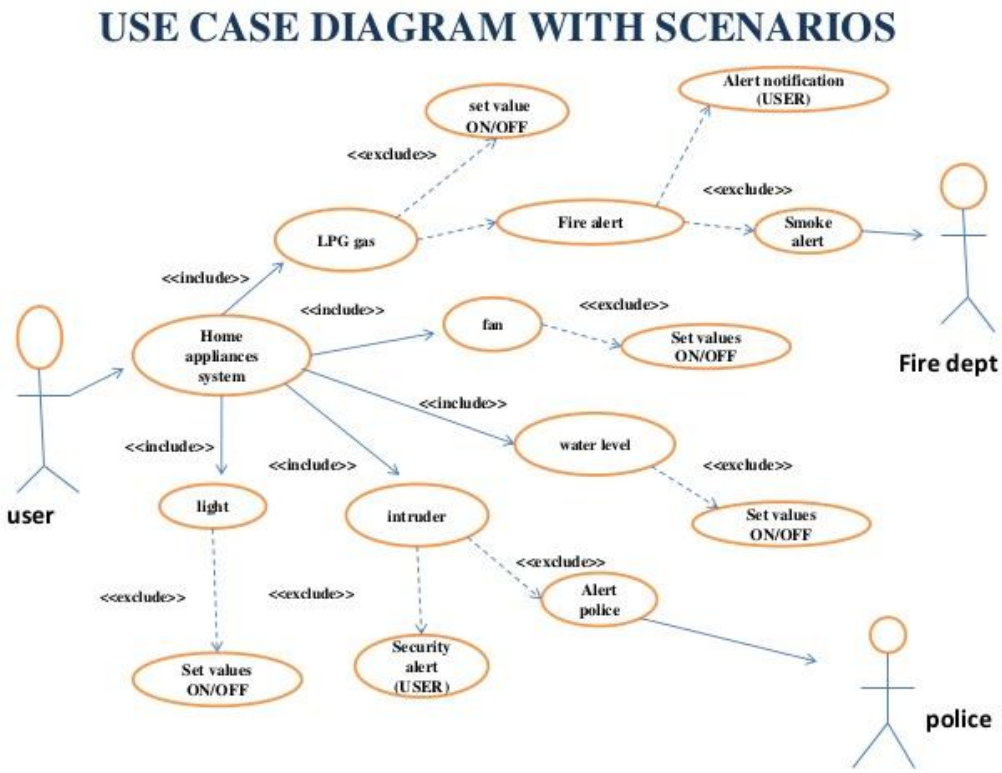
```
Uploaded
4
got
```

ii) No_of_eggs <4

Result:

```
<Response [200]>
3
got
<Response [200]>
---->>>message
<Twilio.Api.V2010.MessageInstance account_sid=AC297f2b4bd856a022f689ae068b3eb076
sid=SM558910ad5ae4449fa8b200b5fe29ab33>
<Response [200]>
Uploaded
```

- **USE CASE DIAGRAM**



6. PROS AND CONS

THE PROS

1. Energy saving

Home automation systems have definitely been tested in the field of energy efficiency. Automated thermostats allow you to pre-set the temperatures according to the time of day and the day of the week. And some even adapt to their behaviors, learning and adapting to their temperature preferences without having to enter a pre-

selected schedule. Traditional or behavior-based automation can also be applied to virtually all devices that can be controlled remotely, from sprinkler systems to coffee machines.

The actual energy savings ultimately depends on the type of device you select and your automation capabilities. But on average, product manufacturers estimate that systems can help consumers save between 10 and 15 percent of heating and cooling bills.

2. Convenience

In today's accelerated society, the less you have to worry, the better. Right? Comfort is another of the main selling points of home automation devices, which virtually eliminates small problems such as turning off the lights before going to bed or adjusting the thermostat when you wake up in the morning.

Many systems come with remote control board capabilities, so forgetting to turn off that coffee maker before leaving does not require a trip back to the house. Simply lift the instrument panel on a smart device or computer, and turn off the coffee maker in a matter of seconds.

3. Security

Remote monitoring can reassure you while you are away from home. With remote control panels, lights and lamps can be switched on and off, and automatic blinds can be raised and lowered. These capabilities, combined with automated security systems, can help you mitigate the risks of intrusions: you will be notified immediately if something unusual happens.

THE CONS

1. Installation

Depending on the complexity of the system, the installation of a home automation device can be a significant burden for the owner. It can cost you money if you hire an outside contractor or it costs you time if you dare to do it yourself.

2. Complex technology

Automate everything in life can sound very attractive, but sometimes a good old-fashioned switch is much easier than reaching your smartphone to turn the lights on and off. Before deciding which system is right for you, think about what you really want to bring home automation in your home.

3. System compatibility

Controlling all aspects of home automation from a centralized platform is important, but not all systems are compatible with each other. Your security system, for example, may require you to log in to a location to manage the settings, while your smart thermostat may require you to log in to another platform to turn the air conditioner on and off. To truly take advantage of the convenience of home automation, you may need to invest in centralized platform technology to control all systems and devices from one location.

4. Cost

Although the price of home automation systems has become much more affordable in recent years, the cost of buying and installing a device can still add up. Consumer Reports offers a wide range of information and perspectives, including costs, on the best home automation systems in the market.

7. CONCLUSION

Smart homes represent a potential research area, and their significance is growing rapidly because of increasing industrial demand. This work presents a general overview of smart home projects that are arranged according to their intended services. It also discusses the significance and limitations of smart home building blocks. The taxonomy of devices, media, protocols, algorithms, methods, and services presents an informative comparison between the associated technologies. This paper identifies several future directions of smart home research. The trends

indicate the increasing popularity of using middleware to integrate heterogeneous devices.

Since multivendor devices will coexist in future, the use of middleware is an efficient solution to create networks that will overcome the limitations of diverse device integration. It seems that home intelligence will be employed in a distributed manner. This distributed intelligence may be applied in the form of smart devices. The system will also use different user interfaces to acquire user feedback, most of which will be based on auditory, visual, and haptic perceptions. Recently, people have become concerned about information security, which can be easily solved by using concepts from computer security and cryptography. The future healthcare service provider will consider the smart home an effective way of providing remote healthcare services, especially to the elderly and disabled who do not require intensive healthcare support. For the same reason, assistive healthcare services will draw more attention to prospective researchers. In the future, smart homes will be connected to various service providers to automate and optimize services. The smart grid is one of the most recent examples of service integration, which is intended to optimize electricity usage according to electricity consumption and production capacity. Smart homes will gain massive popularity in the future because current trends indicate that they are becoming the center of intelligent service consumption.

- **ENHANCEMENTS**

  The benefits of an intelligent home automation range from comfort and safety to energy efficiency and cost savings. All these factors continue to ensure that the home automation sector is constantly flourishing.

  Much of this can revolve around data on the usage patterns of our devices. Each equipment manufacturer or supplier of home

automation devices can, in theory, collect all these data and use them to create flexible modular solutions.

Unlike a few years ago, technologies for the smart home will be more accessible, integrated and economical to buy as the industry develops over time and matures in the consumer market. Eventually, all automation possibilities will reach a point where a single device is required to control our homes. Eventually, this can be a control center or communications itself, dealing with multitudes of peripheral devices and ensuring that they are functioning as they should and when they should.

This future would involve trusting computers and robotics to manage our homes and all our habits and data. The security of this data is, therefore, an area that should grow with this sector. Ultimately, the consumer will always be in charge, programming their personal needs and ensuring that any automation improves their lifestyle. As technologies improve, the automation of certain unproductive or time-consuming tasks will be the norm. In many ways, it seems that the future is not far away.

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