بسم الله الرحمن الرحيم

University of Palestine.

College of Engineering &Urban planning.

Proposal For:

iOS Application For Smart Home (HASec)

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Chapter one

INTRODUCTION

1.1 Background:

Today we are living in 21st century where automation is playing an important role in human life. Home automation allows us to control household appliances like light, door, fan, AC etc. It also provides home security and emergency system to be activated. Home automation not only refers to reducing human efforts but also energy efficiency and time saving. The main objective of home automation and security system is to control home appliances by using different techniques like android application, web pages, GSM when a person is away from home. The system alerts the person in case a burglar enters the house by sending SMS on person's mobile phone which will enable them to protect their home from burglars. The system also helps old people by controlling home appliances with the help of their mobile phones as they do not need to go to different locations for turning the appliance ON or OFF.

Main purpose of home automation is "SAVE ELECTRICITY". With this technology everyone can control the home equipment or office equipment automatically. The system is secured, user- friendly, reliable, flexible and affordable.

Different techniques have been employed in order to implement home automation and security system efficiently. This research paper discusses Arduino, GSM, and Android based Home Automation and Security System with their implementation.

Home Automation and Security System based on Arduino implies that whenever a person will enter the house then the count of number of the persons will get incremented, bulb will start glowing and alarm will start ringing. The count of the number of persons present in the room will be displayed on the LCD screen. Whenever the room gets empty i.e. the count of the person reduces to zero then the bulb will automatically stop glowing making the system power efficient.

Home Automation and Security System based on GSM and Android application implies that whenever a person tries to enter into the house then a SMS will be sent to house owner's mobile phone indicating the presence of some person inside the house and the house owner can take some preventive measure in order to protect his house from the burglar. More over the person can control the home appliances using an android application present in the mobile phone which will reduce the human hard work. The list of various home appliances along with TURN ON and TURNOFF buttons will be provided in an android application. By clicking on that particular button, the person will be able to TURN ON and TURN OFF the home appliances using an android application.

1.2 Motivation for the Research:

With the advancement in technology, the number of electronic devices in our day-to-day Life has increased to make life simpler. So, there is necessity to construct a trustable Remote System that will easily control all these devices from a distance will not only reduce the complexity of handling the number of devices simultaneously, but also save power. This report presents overall design of **iOS Application for Smart Home**. This is an IoT based project. After research, we make a successful prototype. Using the Ethernet

and microcontroller technology we design a Home Automation System where the entire electrical item will be controlled. Using the internet people can also monitor room temperature, Gas occurrence in kitchen, detect human in room through the user-friendly Web Application and also makes a SMS notification system. Comparing to others this system is low cost, attractive user-friendly interface which is platform independent and it's very easy to install. After implementation of all functions, the system is tested in different stages and it works successfully as a prototype.

1.3 Problem Statement:

There are many restrictions and problems that people face to monitor and protect their homes from any particular theft and to keep an eye on children from any harm.

1.4 Research Question:

1. How to protect the house from any theft?
2. How to protect the home from any security attack?
3. How to protect the house from fire?
4. How to make my children safe at home?
5. How can I control my home?
6. How can this app be easy to use?

1.5 Research Objectives:

1. Develop an app to control the home and control the cameras.

2. Evaluate this app to know if this app works correctly.

1.6 Significance of the Research:

1.7 Scope of the Research:

This project is not limited to anyone, it is aimed at all people, especially those looking for safety and control in the home.
This project work completes on its own, remotely and automatically.
So that the homeowner can fully control the house, including temperature sensors and cameras, and provide automatic switching of devices wirelessly via phone, internet, or voice commands.
It sends a feedback message indicating the current state of the home.

Chapter 2

LITERATURE REVIEW

2.2 Introduction:

The background of this study and a brief description of the study settings were introduced in the previous chapter. This chapter will continue on the discussion and ideas in previous work related to the iOS Application of Smart Home and usability evaluation. The discussion will go through some details related to the study.

2.3 Smart Home:

Smart Homes, also known as automated homes, intelligent buildings, integrated home systems or demotics, are a recent design development. Smart homes incorporate common devices that control features of the home. Originally, smart home technology was used to control environmental systems such as lighting and heating, but recently the use of smart technology has developed so that almost any electrical component within the house can be included in the system. Moreover, smart home technology does not simply turn devices on and off, it can monitor the internal environment and the activities that are being undertaken whilst the house is occupied. The result of these modifications to the technology is that a smart home can now monitor the activities of the occupant of a home, independently operate devices in set predefined patterns or independently, as the user requires.

Smart home technology uses many of the same devices that are used in assistive technology to build an environment in which many features in the home are automated and devices can communicate with each other.

The root of this ability to communicate between devices lies in the use of the 'busline'. A busline is a cable that connects all the devices together and enables interconnectivity between devices in different room throughout the home.

With the important development of the internet and the high-speed access (ADSL, satellite, optic fiber ,…), the potential of home working and teleworking is becoming possible.

So, since several years, lots of projects about smart homes are emerging. Those projects are oriented multi-media access (Internet access, telephony, video...), thermal comfort, safety. Smart homes are now dedicated to simplify the life of its inhabitants, to make energy saving, to provide comfort and security solutions.

In recent project, it has been shown that the smart home technologies have reached a good state of maturity but the spreading is still marginal and mostly restricted to demonstration projects

2.4 Proposed Design:

1. *Main Flowchart of Smart Home App*:

An initial step to activate this app, user must connect smartphone's Bluetooth with Bluetooth client (installed at raspberry). There are 6 status at Bluetooth connectivity paired, paired and available, paired and available and enabled, paired and available and disabled, paired and unavailable,

not paired. If Bluetooth has connected, users can utilize their App for controlling Smart Home.

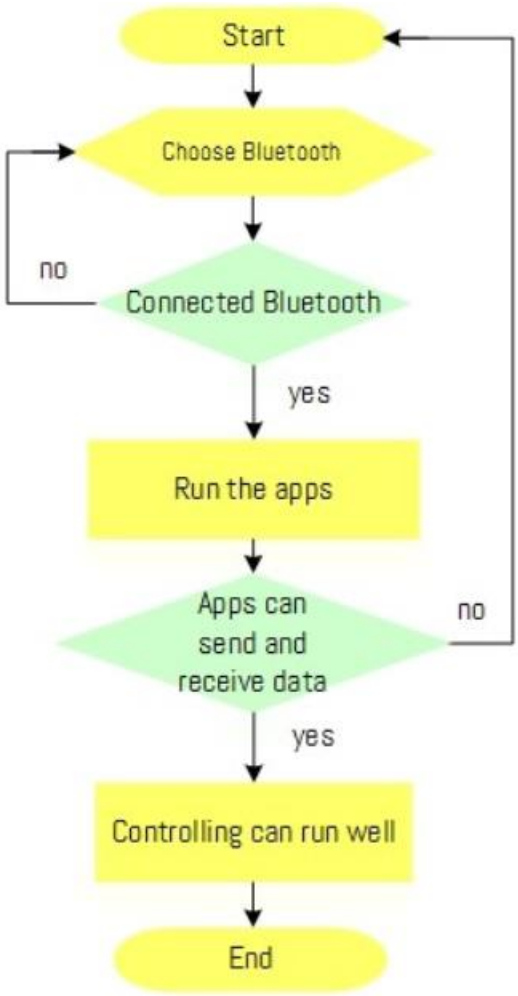


Fig. 2. Flowchart design of main system

There are 3 command design, first is “on” and “off” (hard control), second is slider (soft-control), and third is request data from the sensors devices (monitor). When App send data to host, then host forward data to the node. After that, node processing these instructions for activating device. When node cannot receive data from App, the distance between smartphone and host shouldn’t too far (not exceed than 150m). Therefore, the user must connect Bluetooth again, this situation happened in button control and slider

control. Other option, they must restart the smart home app. A flowchart of main program can be shown in Fig 2

2. *Sub-Flowchart of Smart Home App.*

Hard-control scheme is used for control a generic power switch, generic lamp, door lock, curtain which only need two logic conditions, `0` and `1`. When user click “on” or “open” button, app send 2 bytes data in ASCII format which contain of 1 byte for device code and 1 byte for instruction “00” or “01”. The instruction can be processed, if the data received well. Then the thumbnail icon in app will be changed. Detail design for hard-control command is shown in .

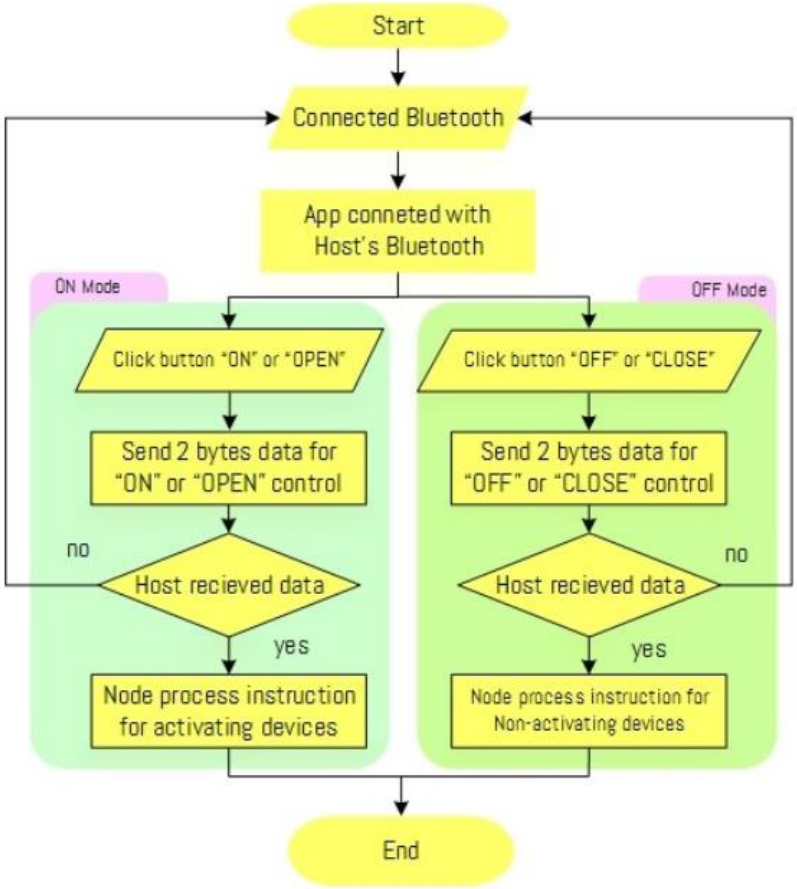
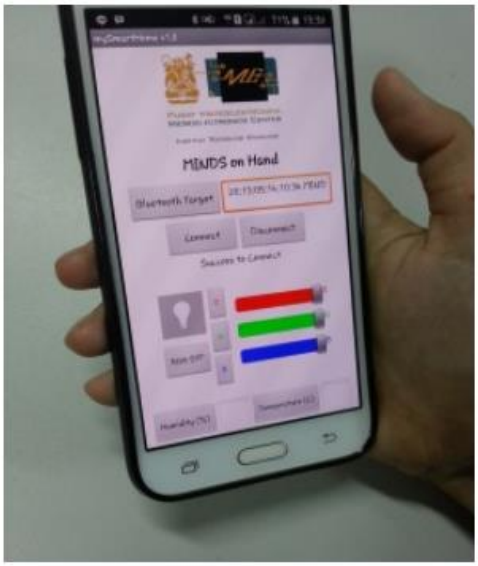


Fig. 3. Flowchart design of hard-control shceme

3. GUI of MINDS-app:

The app interface is shown in Fig 7, it is called “my smart home app version 1”. We develop this app-based flowchart which defined before (Fig. 2, 3, 4, 5 and 6). The output file is an (.ask) format, thus we assume it will compatible to install at several smartphone type with android operating system (OS).

The app contains one screen and set with lengthwise along with vertical axis in order to serve easy operation for everyone user (scroll down only). An original app has 2,280 Byte memory, this value will be change if it was installing at various 1smartphone types.



(a)

(b)

The testing App use Samsung Galaxy Note II running the Android 4.4.2 Kit Kat: (a) the top screen of app; (b) then scroll down to see the bottom screen

2.5 System Description:

In this part we introduce an app design for controlling and monitoring home appliances which refer from earlier research Architecture system which is shown in Fig. 1 is the fragmented block of our complete system [1]. According to Fig. 1, our system includes four parts: user app as remote control, the hosts as brain of system (cover microcontroller, Bluetooth and Zigbee module), multi-devices target, communication topology and protocol format [2]. So far,

multi-devices of smart home are covered with a number of eight devices, we divided into two parts, electronic based [3] and mechanical based [4]. Then its electronics driver methodology was examined detail in [5].

Fig. 1. Smart home system

2.6 Cloud and Server Side:

Control of Cameras:

Since HASec provides the user with the flexibility to choose any type of video-capture devices (e.g., webcams linked either internally or externally to the server, or IP cameras in the cloud), we had to account for each of their distinct design details and adapt a solution that would seamlessly integrate them into one cohesive application. Of the two types, generic webcams were more difficult to implement since they presented a a unique challenge to allow the user to simultaneously view and record live video. We coded a video-capture program in C++ that responds to RECORD/STOP commands using DirectShow, Microsoft's multimedia framework and API [6]. It records video to an AVI file, which is then converted to a playable MP4 file with MPEG's open-source multimedia converter.
If the user is only allowed to view the live video without the option to also record, as done by other applications, the implementation would have been relatively simple. However, us the goal was to provide the user with the flexibility to record the stream while viewing it on a mobile device. The problem we encountered was that the stream could not be viewed until the the recording had stopped. We overcame this challenge by invoking the open-source VLC media player (from the script for controlling cameras) to access the input stream via Direct-
The show, duplicate it, and process it in the following two ways:

- Transcode and record to an MP4 file,

- Transcode to Motion JPEG (so mobile web browsers

can natively view the live stream – without any additional plug-ins) and stream to the webserver.

This also allowed us to avoid splitting or sharing the input stream.

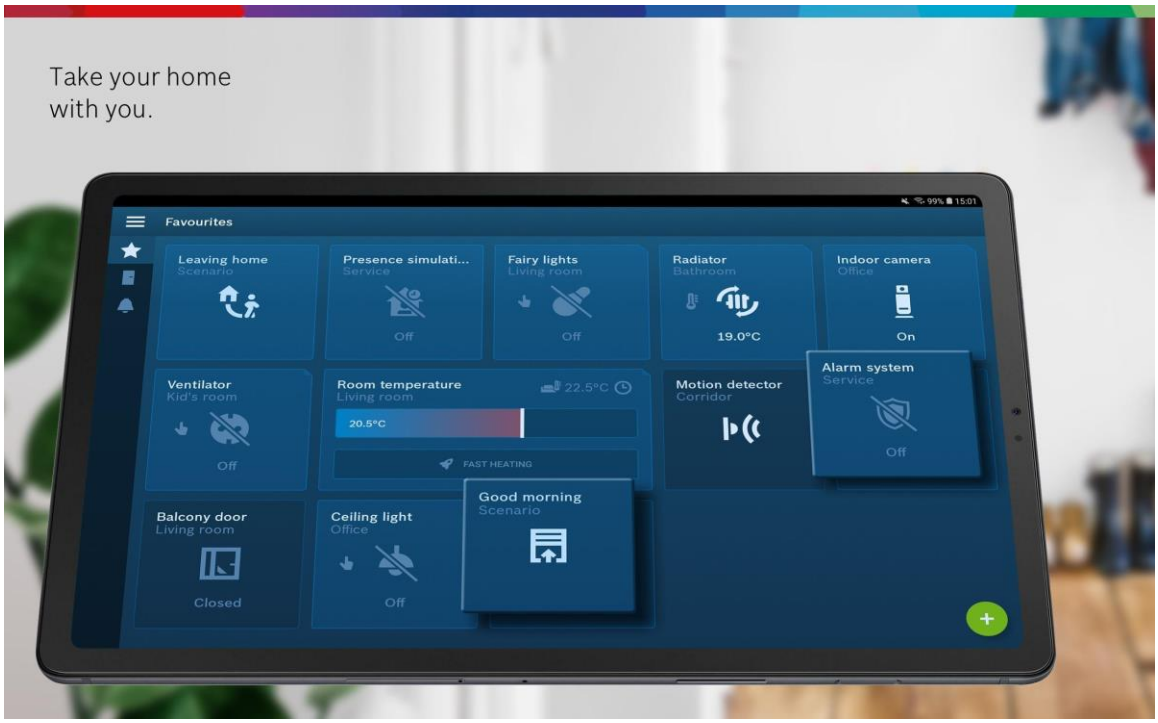
The IP camera, on the other hand, provides a Motion JPEG stream, so we employed a VLC media player to transcode and record the input stream to an MP4 file. To ensure that the PHP the script continues to execute before the C++ and VLC programs exit (in other words, without waiting for those applications to terminate), it is executed as a background process.

Data Storage and Retrieval: Recorded videos are stored on the webserver with timestamps as the filenames (e.g., 2010-07-21_12,13, 18.mp4). To display the list of recordings in our application, the PHP script for recordings reads the contents of the video directory in reverse chronological order parses the names of MP4 files (e.g., 2010-07-21 12:13:18), and places them into a hyperlinked list. Next, using the open-source ui library, the list is formatted to match the iPhone Human Interface Guidelines and the resulting web page are embedded into our application. The user simply has to tap on a timestamp on the iPhone, to launch the corresponding video.

Control of home Appliances:

based on user input, the iOS application sends instructions to the webserver – for example, brighten “Desk Lamp” to 100%. The PHP script for

controlling home appliances convert the human-readable device codes to the matching device codes (that is, house and unit codes) and then sends the command to the X10 PC Interface via the Active Home Pro SDK. These codes are set on the Lamp/Appliance Module and used by the X10 interface for power line communication with the device.



Home Security:

We chose to combine home automation and home security into one application because of the user-friendliness and ease of use that it enables. Additionally, this integration allows for the customization of the final product as both components strengthen each other. For example, cameras integrate with X10, particularly motion detectors, to allow for better security. If we only had cameras, we would not be able to determine the the occurrence of an intrusion. Likewise, if we had only implemented the home-security component (e.g., motion sensors) then we would not be able to send the user a live feed of the video to see who/what was intruding if a

motion was detected. Our system's default response to motion detection can be modified to fit the needs of the user. The user's devices (motion sensors, cameras, and home appliances) act as the home security a system that can be enabled or disabled in the HASec application.

2.7 Client Side:

The iOS device, executing our application, acts as a thin client that provides the user with a graphical user interface. We chose the thin client approach because of the limited computational resources of mobile devices.

Since we must have a home computer anyway to communicate with the device controllers (because of X10's closed-source SDK), this approach was best suited for the task at hand.

Based on user input, our application is built to communicate with the web server by sending commands to control and manage devices located around the home.

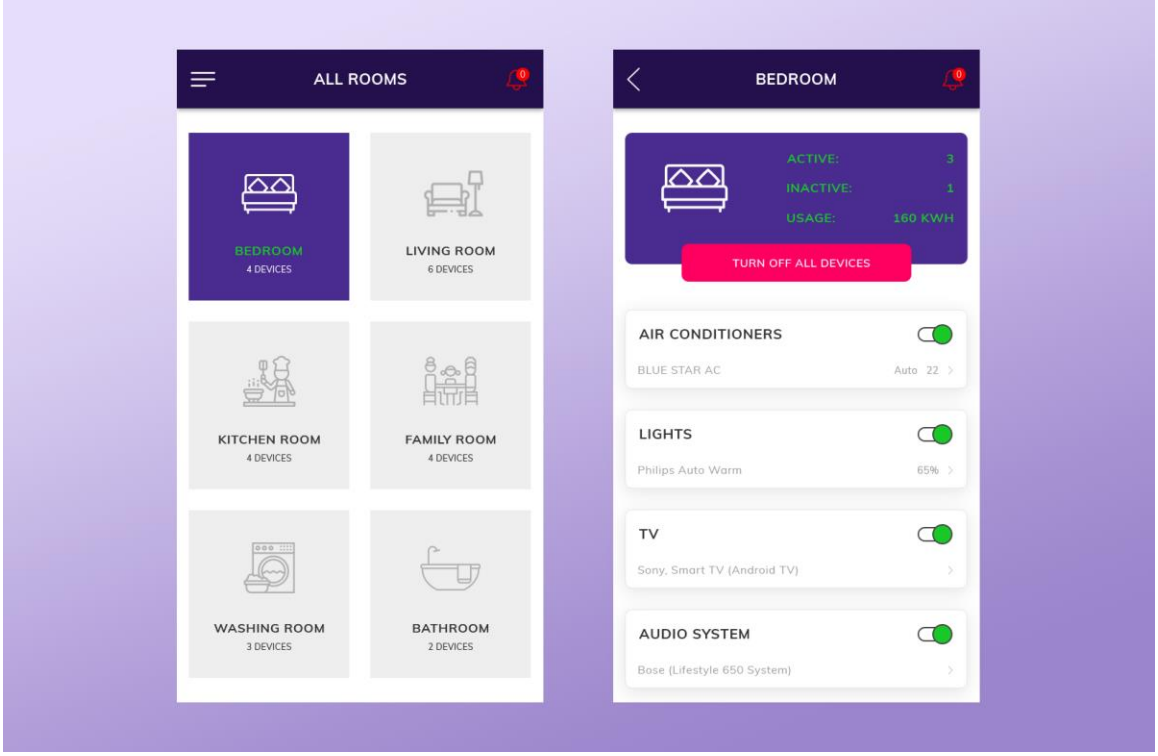
the home page in the application contain the list of all rooms in the home , each room contain a group of devices connected with the central hub .

When you open the room page, you can control all the devices inside the room,

They can include lamps and simple (ON/OFF) appliances such as television, computer monitor, alarm clock, and so on. X10's Lamp Module allows for changes in light intensity and we provided both a slider and a text field to control the percentage of brightness. The user can specify the intensity using either one. Implementing the slider presented a challenge: typically, when a slider is pressed, it automatically (and continuously) sends its value to the server until it is released. However, we observed that this results in many

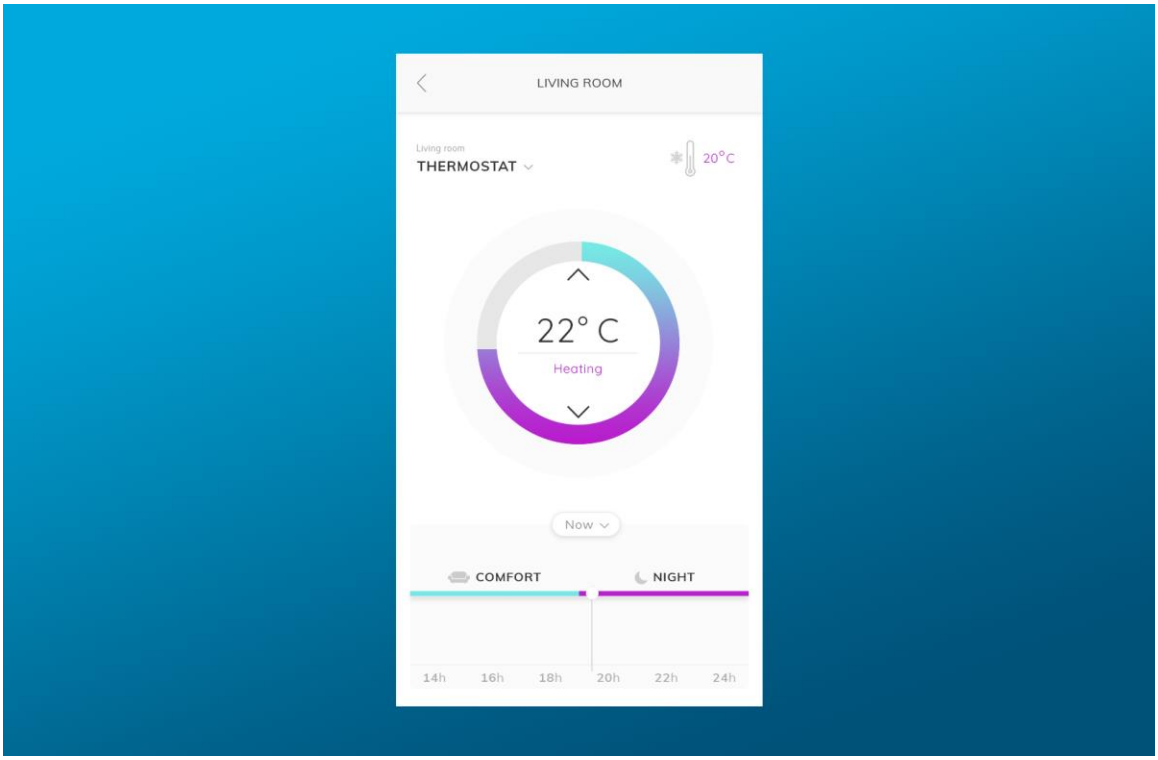
unnecessary commands that can burden the X10 PC Interface and add excessive delay. Hence, we modified the slider so as to only send the final value.

as shown in the figure below



The Cameras preview page, where the user has the option of viewing one or two cameras. The live streams are loaded from the cloud, either directly from an IP camera or from the server, and are shown split-screen. The user can then view the cameras individually with the zoom feature and PAN/TILT them if supported. The user can start or stop video recordings (from one or both cameras) in the preview and individual pages.

A single-tasking smart home app is designed to control only one IoT device for smart home automation. With these apps, users can control one smart home device as shown in the figure below.



2.8 Smart Home Components:

1. *The Central Hub:*

The central hub is the main device, the brain of the entire system. The central hub is a device that works as a smart home control panel and creates a connection between the smart home app and the rest of the devices.

2. *Sensors*:

The smart home sensors are necessary devices that receive intel about the external conditions, such as the state of humidity and

temperature around the house, water leakage features, motion sensors, etc.

3. *Wi-Fi:*

It is probably the best and most popular way of connecting the smart home devices to the gateway. Most devices today come with Wi-Fi compatibility, although it might burn too much battery and energy to run the devices on Wi-Fi all the time.

4. *Bluetooth*:

The standard technology for exchanging data with a fixed mobile device, Bluetooth can be considered as one of the connectivity solutions for smart home IoT. with Bluetooth, users can easily control smart home devices from their smartphones and tablets. With Bluetooth, users can save batter and energy because it is a low battery consuming connectivity technology.

5. *Z-Wave:*

Developed by Zensys, Z-Wave is a mesh network that helps the home automation devices to connect to each other. With Z-wave, devices use low-energy radio energy, which ultimately saves battery and energy.

With Z-Wave, users get a large open-air operating range of 90 meters outdoors, and the operating range of more than 24 meters indoors.

6. *Zigbee*:

Zigbee is one of the most convenient wireless protocols used for smart home automation. Most of the recent smart home devices are compatible with this connectivity protocol. However, Zigbee works at a 2.4GHz frequency, which is similar to Wi-Fi and Bluetooth. Which is why there can be network interferences.

Now that we have discussed the smart home system components and connectivity options, it's time to come down to the real issue at hand- how to develop a smart home system.

2.9 User Evaluation:

We conducted experiments to first measure the latency of streaming video from a remote location for two cases (average network congestion and high network congestion) and then expanded the scope of our evaluation to include other tests as well. These results were recorded for 6 successive latency measurements 20 seconds apart (totaling 2 minutes) and then averaged them. We repeated each experiment 10 times. For the first scenario, depicted in Figure 5, we used high resolution of 640×480 pixels and the highest allowable frame rate allowable by iOS device, i.e., 7.5 frames per second (fps). We tested both an IP camera and a webcam separately as well as together. As expected, the results for the individual streams (approximately 2–5 seconds) are lower than those for the simultaneous streams (approximately 3–7 seconds). Even the high-quality video performed well, especially with simultaneous streams.

The second scenario, shown in Figure 6, exhibited a worst case or stress test. In this scenario, we used a high traffic network (performed during busy hour) while continually using simultaneous streams. We did this for three resolutions: high (640×480 pixels, 7.5 fps), medium (320×240, 5 fps), and low (160×120, 2.5 fps). As expected, the reduction in delay is proportional to the quality of the video streams. However, even in the worst-case scenario (of this stress test) the delay is never greater than 10 seconds. We experimented with different streaming qualities. We observed that if a HASec user is using a poor-quality network (due to a slow connection or high network traffic), then we can adaptively reduce the quality of the video stream and thus continue to achieve good performance (2–6-second delays in the worst case).

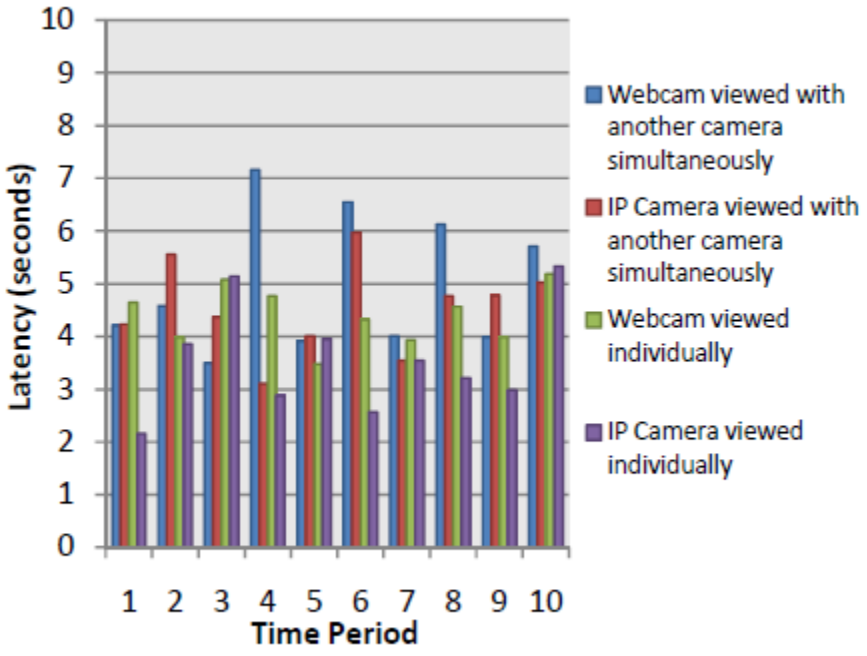


Figure 5. Latency of high-quality streaming in network with average traffic.

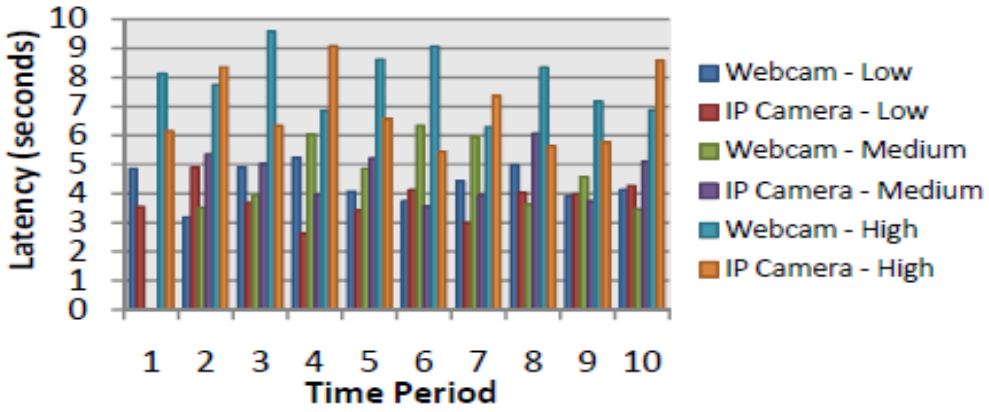
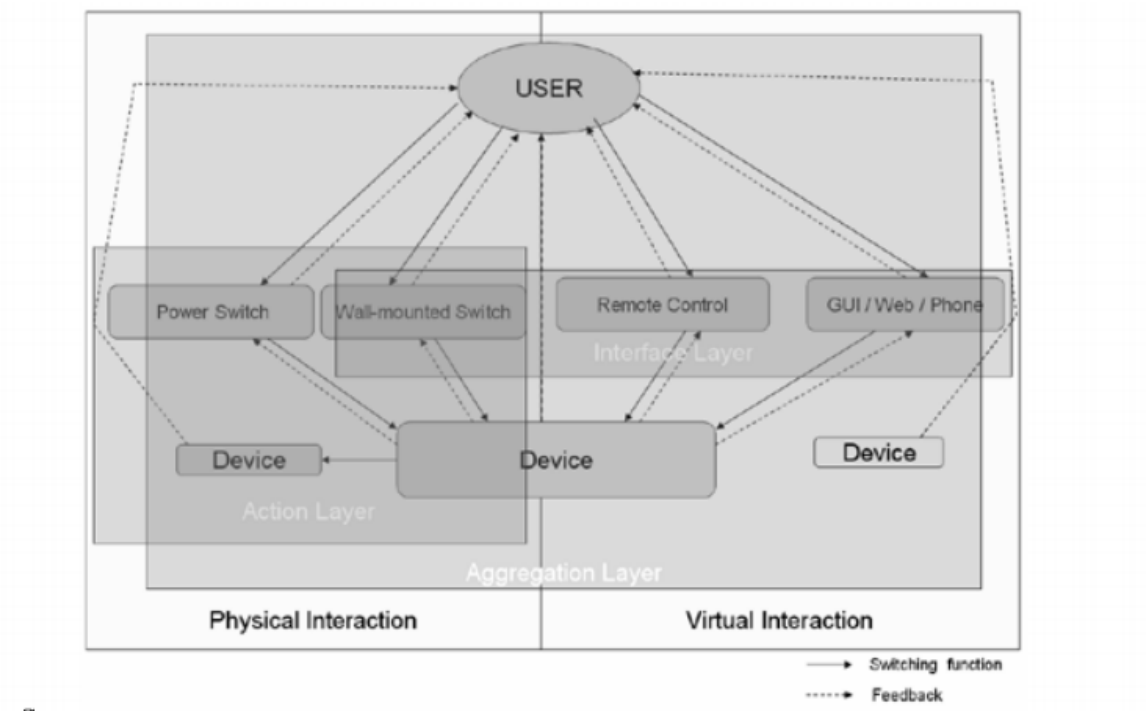


Figure 6. Latency of variable-quality streaming in network with high traffic.

2.10 Usability Evaluation:

The investigation of usability aspects related to smart home appliances is difficult because several areas of usability research are linked together in one problem domain. One common shortcoming of the related work presented in the previous section is that only singular aspects have been addressed, focused on the user interface. However, smart home appliances affect at least two areas of usability: real world usability issues, e.g., the ergonomics of door handles, wall mounted switches [7] as well as usability issues related to software or Web interfaces. Furthermore, if mobile system components are in use, additional aspects regarding mobile usability have to be considered. Thus, ensuring usability in smart home environments is a difficult and multidimensional task. To address all relevant dimensions, it is necessary to specify a framework which serves as the basic structure for usability research related to smart home appliances. Complex smart home systems are integrating distinct paths of manipulation and feedback, e.g., one user is switching a device with a power switch while another user who is accessing the system via Internet is retrieving feedback on the current system status. Figure illustrates the possibilities of interaction between a user

and a smart home system. To keep the model simple, only the most immediate switching and feedback loops are presented.



2.11 Summary:

we developed a comprehensive solution called Haze that provides a user-friendly home automation and security apple-cation. We accomplished this through the integration of cheap, off-the-shelf, widely available devices, interfaces, and soft-ware coupled with a user-friendly interface. HASec provides users with an easy-to-use mobile application from which they can remotely access and control their home appliances and security. The proposed architecture of HASec operates under the client–server model, with a mobile application as the client and server in the cloud connected to external devices. HASec can be accessed by any web-enabled device through browsers. Our flexible architecture allows extending HASec to other

mobile devices as well, such as BlackBerry and Android, as well as integrating other security systems. In the future we intend to add temperature and power-usage readings, thus leading to manual and automated energy-efficiency solutions.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction:

This chapter elaborates the research methodology which is adapted from Agile Methodology System

3.2 Design Research Methodology:

Scholars today believe that without system development, research has no used and without research, development has no base [8]. However, there are numerous methodologies available today that can be used as a guide to develop various types of systems. As [9], methodology is used to ensure a consistent approach is applied to all phases of a project. Methodology also facilitates project accomplishment by structuring the related processes according to the phase defined.

The methodology for this study was adapted from the Agile Methodology System. The prototype (Smart Home) was developed with iOS Language using Swift [10], as the Integrated Development Environment (IDE).

File Maker Pro 2020 was used as Database to store and retrieve all information.

The design of the prototype took into account the status quo to make moderation of a new set of abilities and limitations brought forth by small and lower-fidelity screens, small amounts of memory and storage, slow network connectivity, and alternative forms of input. The adapted methodology as shown in Figure 3.1 consists of Five phases: Requirement of the project, Design of the project, Develop, Testing, Deploy. Details of these phases are following:

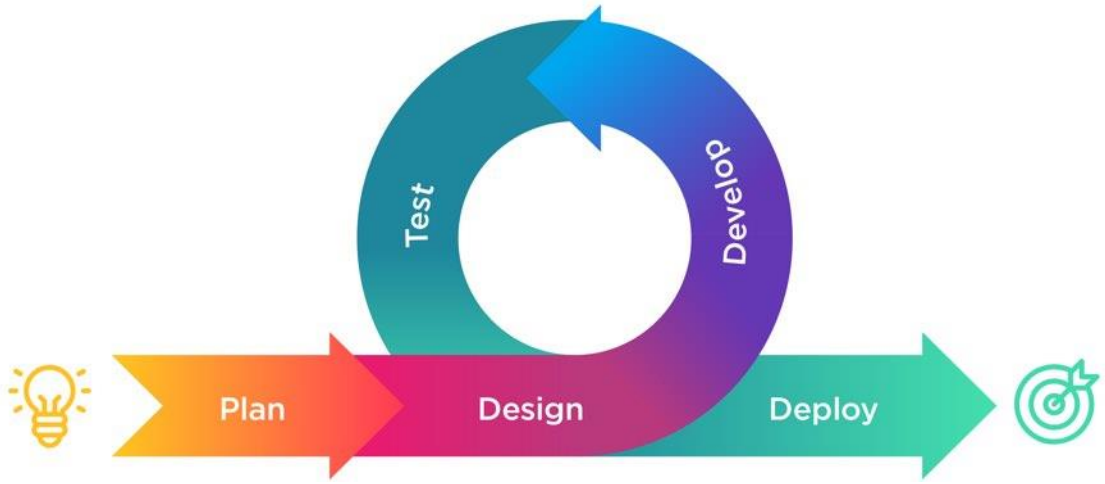


Figure 3.1: Agile Methodology System

3.3 Requirement of the Project:

Smart Switch Circuit Board. The smart switch utilizes the SOC (system on chip) power metering chip, which can achieve intellectual detection of the power net and the power usage of the electrical equipment such as LED energy saving lamps, air conditioners, refrigerators, and microwaves. The smart switch circuit board

Communication Protocols. The communication is achieved using the master/slave model, which means the equipment (Wi-Fi switch) will not report information conditions or control information on its own initiative. The controlling device (cellphone) and the

device controlled (switch)
are in the same LAN, through which the data control frames
are transferred using the UDP protocol. The control command frame can be divided into the master frame and the
slave frame, and the format of each is as follows.

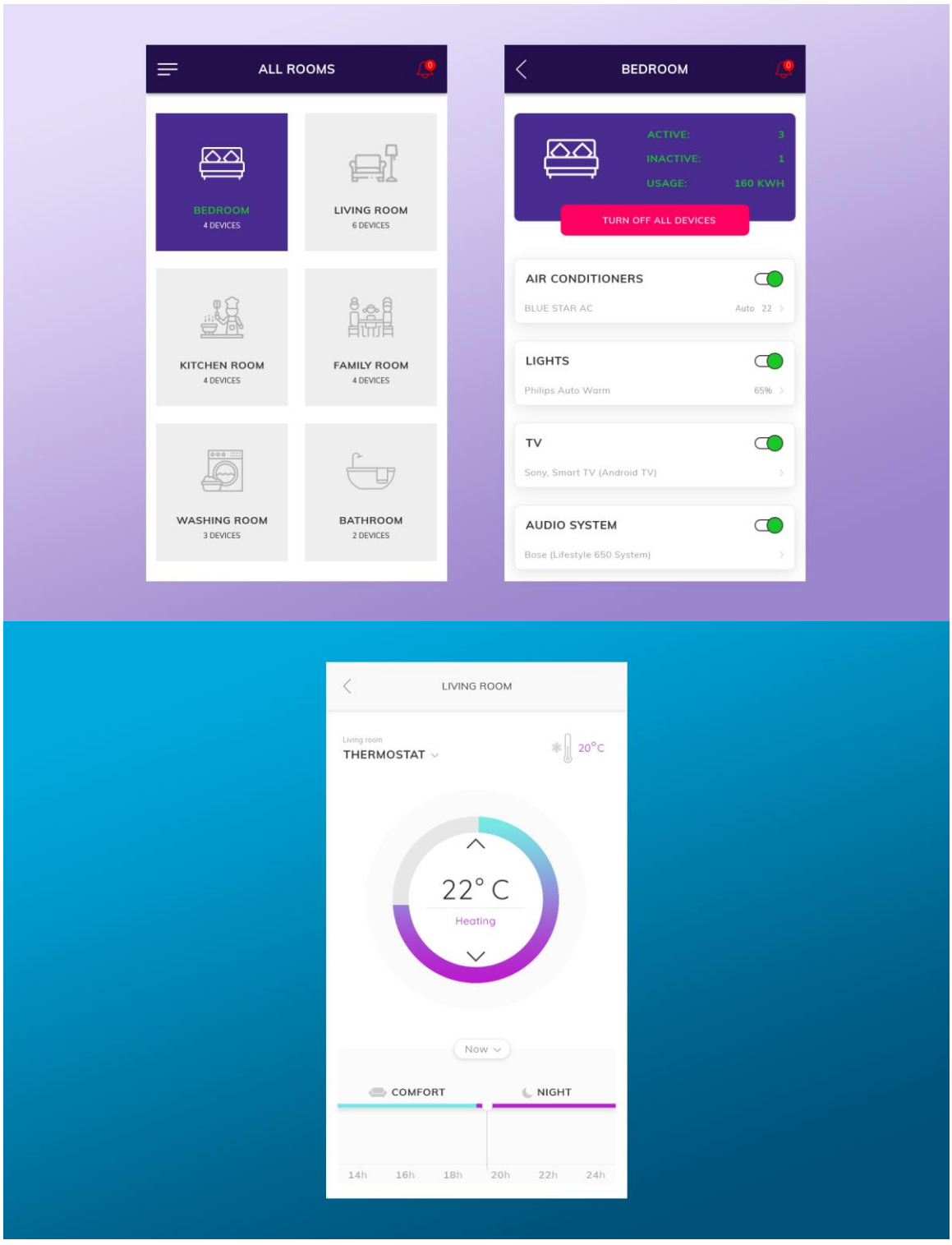
Master Frame. The master frame is the control command that can be sent to the devices.

The Slave Frame. The format of the slave frame data is the same as that of the master frame. There are certain differences in regard to the device interfaces. The slave device data frame includes the hardware details of the slave device.

3.3. The Realization of the Smart Switch Plugin Function. The plugin-based model is used to encapsulate the local API, including the public and the user-defined application with a unified plugin interface for the upper level to invoke the application module conveniently.

3.4 Design:

The second phase of the Methodology is the Design. In designing, we bring in a professional designer (ui/ux Designer) who is proficient in designing an application that is compatible with all small and large devices and has the ability to know the persona. We used the Adobe XD application to design the application before sending it to the programmers to Develop this figure we show some of the pages:


ALL ROOMS
BEDROOM
4 DEVICES
LIVING ROOM
6 DEVICES
KITCHEN ROOM
4 DEVICES
FAMILY ROOM
4 DEVICES
WASHING ROOM
3 DEVICES
BATHROOM
2 DEVICES
BEDROOM
ACTIVE: 3
INACTIVE: 1
USAGE: 160 KWH
TURN OFF ALL DEVICES
AIR CONDITIONERS
BLUE STAR AC
Auto 22
LIGHTS
Philips Auto Warm
65%
TV
Sony, Smart TV (Android TV)
AUDIO SYSTEM
Bose (Lifestyle 650 System)
LIVING ROOM
Living room
THERMOSTAT
20°C
22° C
Heating
Now
COMFORT
NIGHT
14h
16h
18h
20h
22h
24h

3.5 Develop:

Swift Language was used for coding the IOS application and using other Cocoa touch frameworks along with XCode and Interface Builder. Includes coverage of bridging to Objective-C code and C libraries.
In addition to File Maker Pro 2020 as a database to store and retrieve all data by integrating with Google Cloud Services. and we used the node is express as a server and using RESTful API (to set and get the data between the IOS app and node.js server).
Agile is about teamwork, which is no surprise since most software today is built by teams. Developers build strong relationships with product management, design, QA, and operations because writing sustainable code means staying connected to all facets of the project. Atlassian has seen huge benefits in code quality and developer satisfaction by empowering developers to work directly with other parts of the business. Better code, less "thrash" (i.e. duplication of effort and/or conflicting streams of work), and more effective cross-functionalism are just a few of the benefits.

3.6 Test:

In Agile, testing is integrated directly into the development process so that bugs are discovered as early and as often as possible. As a result, testers can identify problems at every point in the development process, moving the product quickly towards release.

1. Test Plan for Agile:

In agile testing, the test plan is written as well as updated for every release.
A test plan in agile includes:

- The scope of the testing

- Consolidating new functionalities to be tested
- Types of testing/Levels of testing
- Performance & load testing
- Consideration of infrastructure
- Risks Plan
- Planning of resources
- Deliverables & Milestones

2. Agile Testing Life Cycle:

The agile testing life cycle includes the following 5 phases:

1. Impact assessment
2. Agile Testing Planning
3. Release Readiness
4. Daily Scrums
5. Test Agility Review

3.7 Deploy:

The last phase of the methodology is Deploy the application to allow the user to evaluate the application. It was conducted to determine users' perception on the usability aspect of the Smart Home prototype.

3.8 Summary:

This chapter discussed the methodology of the research. It was guided to develop and evaluate the prototype. The methodology was adapted from Agile and it includes five steps: Requirement, Design, Develop, Test, Deploy

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