IOT Home Automation and Security Surveillance System

Major Project Report

Submitted in fulfillment of the requirements
for the degree of

Master of Technology
in
Electronics & Communication Engineering
(Embedded Systems)

By

Tirthesh Shah

(16MECE20)

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Under the guidance of

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Declaration

This is to certify that

a. The project report comprise my original work towards the degree of Master of Technology in Embedded Systems at Nirma University and has not been submitted elsewhere for a degree or certificate.

b. Due acknowledgment has been made in the text to all other material used.

- Tirthesh Shah

16MECE20

Disclaimer

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Certificate

This is to certify that the Major Project entitled **"IOT Home Automation and Security Surveillance System"** submitted by **Tirthesh Shah (16MECE20)**, towards the partial fulfillment of the requirements for the degree of Master of Technology in Embedded Systems, Nirma University, Ahmedabad is the record of work carried out by him under our supervision and guidance. In our opinion, the submitted work has reached a level required for being accepted for examination.The results embodied in this major project, to the best of our knowledge, haven't been submitted to any other university or institution for award of any degree or diploma.

Date: 17 May,2018 Place: Ahmedabad

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Certificate

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Abstract

The IOT(Internet of Things) is the buzz word in technology today, which is useful for the different applications like Smart Surveillance, Automated Transportation, Environment monitoring, Home Automation, Industrial Automation and many more.There are available different module based automation for specific target in home or premises. Which increases the cost to make full automation system. The goal is to make the full home automation system, and the proposed microcontroller for testing is choose to be arduino uno based model interfaced with Bluetooth HC05 module useful to control relay connected devices and the sensors. The input data is observed on terminal and later will be display on interfaced LCD display. We used IOT for Home Automation to control or monitor the light, temperature, water level, human detection and smart security video surveillance. The use of Video Management System software for video monitoring and configuration and testing of features for the IP digital cameras. Study the security surveillance camera setup which require NVR-Network Video Recorder or DVR-Digital Video Recorder, network switch, power supply and connectors and cables. The Security Surveillance camera setup, configuration and connections for better performance and results is optimized. The testing of features and camera response is carried out to optimize the VMS software for better extraction of information for surveillance. To provide better storage option, since the limited storage available for backup, the VMS(Video Management Software) performance for the different resolution based recording and at different frame per second is observed to state the best performance operation capability of different camera which will be used as per their performance for different premises monitoring and provide security. Final system provides the full home automation with new and advance features like smart security surveillance and basic home automation modules synchronized and thus provide user the IoT advantage in day to day life.

List of Abbreviation

AI ..... Artificial Intelligence
AWS ..... Amazon Web Service
AVC ..... Advanced Video Coding
CCTV ..... Closed Circuit Television
DVR ..... Digital Video Recorder
FPS ..... Frames Per Second
IDE ..... Integrated Development Environment
IOT ..... Integrated Of Things
IP ..... Internet Protocol
LCD ..... Liquid Dependent Resistor
LDR ..... Light Emitting Diode
LED ..... Light Emitting Diode
MBPS ..... Mega Bits per Second
MJPEG ..... Motion Joint Photograph Expert Group
NVR ..... Network Video Recorder
PoE ..... Power over Ethernet
PTZ ..... Pan Tilt Zoom
SPDT ..... Single Pole Double Throw
SSR ..... Solid State Relay
HEVC ..... High Efficiency Video Coding

Chapter 1

Introduction

1.1 Company Overview

eInfochips Limited, An Arrow company, is a leading global provider of product engineering and semiconductor design services. With over 500+ products developed and 40M deployments in 140 countries, eInfochips continues to fuel technological innovations in multiple verticals. The companys service offerings include digital transformation and connected IoT solutions across various cloud platforms, including AWS-Amazon Web service and Azure. Along with Arrows 27B Dollar in revenues, 19,000 employees, and 345 locations serving over 80 countries, eInfochips is primed to accelerate connected products innovation for 150,000+ global clients. eInfochips acts as a catalyst to Arrows Sensor-to-Sunset initiative and offers complete edge-to-cloud capabilities for its clients through Arrow Connect.

1.2 Motivation

People day by day are interested to get more and more automation in the appliances and bring the level of luxury in living. The automatic Cars, Smart Phones, Smart Watch, etc. are example. Sometimes due to hurry or by mistake the appliances of home are left On, which can cause waste of energy, or sometimes can cause

led to accident is case of industrial applications. Some senior citizen or handicapped people needs to rely on person to do the same for them. Thus the home appliances if are made to connect wireless using IOT system which can provide control or monitor to user, than the situation can be controlled and thus also reduces the human efforts to get up and actuate the activity of switching or controlling the appliances. The Security Surveillance can be equally helpful for monitoring the activities and extracting the useful information from the recorded file.

1.3 Problem Statement

As the technology advances, more and more innovation are arising to bring the leisure to human and automation makes devices to operated by machine rather than man to improve the performance and reduce the human efforts.The system with small module automation are available, but the single system for full home automation is targeted. To bring the full home automation system design to be able to control appliances using the single smart phone, with lower implementation cost and more function control is in demand. Also for the security purpose the video surveillance camera system is helpful for monitoring and extracting useful information of the recorded data.

1.4 Approach

There are devices which are using LED to display the water level or display the current status of motor, display only the On/Off state of motor, and so on, thus the design target here is to achieve the full control and monitor to the smart phone also the LED and 7 segment display on board to have offline access or control on absence of the smart device. Thus the Home Automation using the Arduino controller interfaced with Bluetooth module makes it possible to communicate with the smart device inbuilt Bluetooth. The development of Video management system soft-

ware with features like human detection, object identification and positioning, event monitoring and scheduled tasks etc will be useful for the security and surveillance of the premises. The testing of the proposed system hardware and available camera configuration for better security support and bring the home automation useful.

1.5 Scope of Work

To control the light,fan, water pump, curtains, parking lot door, of the Home using the smart phone app and make also monitor the current status of the appliances or state of device. The sensors helps to make the current state decision and take decision to switch On/Off the appliances. While motors and conveyor belt can be used to actuate the output for the system. The video surveillance security setup and the video management software for recording and extracting the features of the setup with more advance and user friendly interface for configuration is the goal. The system will be low cost design to be made available to more number of people and more efficient in terms of available features and power consumption. Understanding the video coding techniques and developing the universal video management software with more efficient performance and advanced features. To develop the security surveillance system and its VMS software for the use in NVR based CCTV setup for home automation is the main target and thus the developing and testing for all the parameters and features is carried out.

1.6 Outline of Thesis

The Thesis is about Home automation and its advantage and requirement in today life. The design philosophy and available technology today, and what is the scope of expansion and improve the technology for better utilization of available resources is mentioned in chapter 2. Chapter 3, explain about the proposed hardware and features for making the home automation with advanced features and security

surveillance using CCTV (Closed Circuit Television) setup. Including the targeted features using the arduino uno board with HC05 Bluetooth module and control using the mobile for appliance switching. The Video Surveillance System setup and requirements, are explained in chapter 3. Camera configuration and mount with the latest firmware. The software requirement for the testing and programming the arduino using arduino IDE and camera operations using the VMS software and understanding the features help for the surveillance and monitoring under different conditions is discussed in Chapter 4. Chapter 5 discuss about the test conducted and modify the coding style or reducing the latency type of issue to be overcome and report the areas which can help to achieve the target results. The results are updated to client for the changes and improving the new version update, for next release to be more optimized and advance with features.

Chapter 2

Literature Survey

2.1 Overview

Home Automation is generally used so to make the user more comfortable in terms of controlling the home appliances remotely or control them with ease and monitor the state. The system designed using the micro controller with interfaced sensors to sense the Light, Temperature, Presence of Human, and control the general appliances using the relay board.

The people sometimes left the appliances kept On due to hurry or may be due to handicapped or senior citizen may cause a movement to control the appliances from a bed or wheel chair to the control board. Thus this type of Home Automation system if installed will be helpful to monitor the status and control the appliances so as to help in Power Saving and also will help to reduce the cause of accident. The device will be battery backed up and also have a power input to charge the battery. Thus the battery backup will provide the backup in case of the power failure. The LED and LCD will be used to show the offline current status of the system and thus the system will be able to provide the offline status monitoring also to the user.

The Security is the core feature now a days due to the increasing crime and threats in the city areas. For premises like home, jewellery shops, offices, industrial

area, all are deploying digital security surveillance system. To provide with the better security surveillance and monitoring of the premises the video management system software play important role for the digital IP camera setup installed. The VMS software with basic set resolution recording also must be having some advance features like event scheduling, object motion detection, human detection, audio transceiver, sensor interfaces etc. Thus continuous testing and improvement help to develop the best in feature and performance VMS system with Home Automation using IoT.

2.2 Present Technology

The system available today are in different modules like, Water Level Indicator and Controller, Light Controller, etc which makes it again difficult for the user to manage the different automated systems and keep control of each remotely, so the central controlling system which will even provide the access to user from remote location and also makes user comfortable to control all from single smart phone.

The different automated modules cost more to user in term of cost and usage of power, also the control for each of the module being different confuses or make it difficult for user to control more number of modules, and that to some are not having the remote access mechanism to operate from remote location like for in case of Handicapped or Senior Citizen with problem in walking or get up from bed.

The user also need to take care for the secured access only by authenticate device or user so as to maintain the control of Home appliances and keep the situation under control. Thus the system design with PIN protection to provide access only to authenticate user makes it secured and thus help the user to make the connection to the system from the smart phone via Bluetooth communication with the system.

The VMS system software is made available by different vendor company to provide support to their digital ip cameras and mostly for surveillance applications. The VMS must be capable to provide the input recorded by camera with proper

set resolution and quality of video must be maintained throughout the period of observation. The storage of recorded must be in proper encoded form to make the maximum utilization of the available resource using the appropriate video encoding technique like H.264, H.265, MJPEG and others. The widely preferred and supported encoding technique used is H.264, due to its capability to optimize the recorded video storage capacity and make use of available storage for longer duration videos. While MJPEG is not used for video encoding due to large storage require to store the same duration video when compared with H.264.

There are security based CCTV camera setup,but no surveillance of the recorded data is available. The user to be made available the goal is to bring the good Digital IP based security surveillance system made available with the powerful VMS software. The available in market digital camera setup are not user friendly in terms of availability of the advanced surveillance system software with features like Audio detection, motion detection, event scheduling, area monitoring, time scheduling. And the one available are having the some limitation with resolution or features.

There are CCTV system installed but based on DVR, thus the setup has limited features for security and thus the NVR based system is useful for security and surveillance both with some extra initial installation cost. The NVR based system has the more features for the user to extract the information of the recorded video and have the advanced features like Auto Tracking, Object detection, Human identification and new features still under process with help of artificial intelligence involvement.

Chapter 3

Hardware Requirements

3.1 Sensors

The sensors for sensing different parameters inside the room can be Light, Temperature, Humidity, Gas, Presence of Human, Water Level, Car Presence etc. The digital security surveillance system require the camera for input the data to NVR. For home automation the Sensor which will be used are:

For Light: The LDR(Light Dependant Resistor), a photo resistor or photocell is a light-controlled variable resistor. With increasing incident light intensity, the resistance of a photo resistor decreases; thus it exhibits the photo conductivity. Useful to set the light intensity depend switching for the Lamp switching automatically for the automation.

Figure 3.1: Light Dependent Resistor [11]

For Temperature : The LM35 sensor is precision integrated-circuit tempera-

ture device with an output voltage which is linearly-proportional to the temperature in centigrade. The LM35 sensor has an advantage over other linear temperature sensors which are calibrated in Kelvin, as the user does not require to subtract a large constant voltage from the output for obtaining convenient Centigrade scaling. The LM35 device do not require external calibration or trimming for providing typical accuracy of ±1/4°C at room temperature and +-3/4°C over the full 55°C to 150°C temperature range. The low-output impedance, linear output, and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy. The device uses a single power supply, or with ±supply. Since the LM35 device draws only 60 A from the supply, it is very low self-heating and less than 0.1°C in still air. The LM35 is rated to operate over a 55°C to 150°C temperature range, while the LM35C is rated for a 40°C to 110°C range (10° with improved accuracy). The LM35D device is a 8-lead surface-mount device, with small-outline package and a plastic TO-220 package.

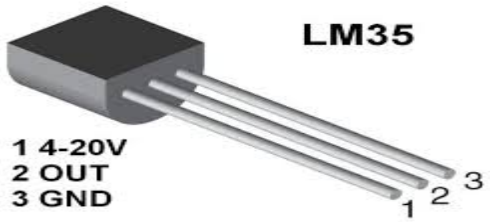

Figure 3.2: LM35 Temperature Sensor [11]

Features of LM35:

- Calibrated Directly in Celsius (Centigrade)
- Linear + 10-mV/C Scale Factor
- 0.5C Ensured Accuracy (at 25C)
- Rated for Full 55C to 150C Range
- Suitable for Remote Applications

- Low-Cost.

Camera: The CCTV camera use either Analog or Digital Camera setup. With the more advantage the digital IP camera are widely used. Security and Surveillance are different by terms as Active or Passive. Surveillance Cameras are Passive, since they observe and/or record whatever is in their view. While Security Camera are Active, they alert people to unexpected events within their field of view. The major manufacturer of camera useful for CCTV purpose are Panasonic, Cisco, Hikvision, Dahua, Zicom, Honeywell, CP Plus, Samsung, and many more.
The common types of digital cameras depend on the mount and coverage area type are:

- Fixed Camera

Figure 3.3: Fixed Camera [9]

- Fixed Dome Camera
- PTZ(PAN-TILT-ZOOM) Camera
- PTZ Dome Camera

The camera is selected depend upon the application area to be set to cover for security or surveillance purpose.

Figure 3.4: Fixed Dome Camera [9]

Figure 3.5: PTZ Camera [9]

The Fixed camera type is set to monitor for the fix area while Dome type is preferred for outdoor area where to protect the camera from weather affects and environmental conditions like rain. In the same way PTZ type of camera is useful to cover the 360 degree pan and tilt for around 180 degree and Zoom In-Out facility depend on brand and model. Other advanced features in new model of cameras are:

- **Auto Focus:** This feature is mostly available in PTZ cameras
- **Night Vision:** This feature is supported by turns off the IR filter to observe the video or image in night or no light conditions
- **White Balance:** The new model of camera identify the source of light and compensate for its colour, which is use to reflect the natural colours

Figure 3.6: PTZ Dome Camera [9]

- **Back-light Compensation:** This feature provides the focused object look more clearer with the bright background
- **Auto Tracking:** The camera lens track the moving object/person depend on the configuration, where pan and tilt is automatically controlled
- **Power Over Ethernet:** This feature is mostly available in all new model of camera to be powered over the network data cable, to carry data and power both the PoE enable switch is required
- **Alarms:** The new hardware like speaker or buzzer is embedded along with the camera lens which can be enabled to alarm when set condition for event or scheduled task occur

3.2 Microcontroller and Devices

The Home automation require the central system controller, so using the micro controller helps to interface the sensor and actuators for the control of the appliances. While for the security surveillance system require Network Video Recorder with PoE switch or external power supply for cameras. The cable for camera and NVR to network switch connections are required depend on type of communication channel used and deployed hardware.

Microcontroller: Arduino Uno, uses chip AT-mega16U2 This makes the faster operations and support the high transfer rates and more memory. The Uno v.R3 next to the AREF signal, adds SDA and SCL pins. Also there are two new pins placed near the RESET pin, one IOREF that allow the shields to adapt to the voltage provided from the board, while other is a not connected and is reserved for future purposes. The Uno R3 works support operation with all existing shields and able to adapt to new shields which provides use of these additional pins.

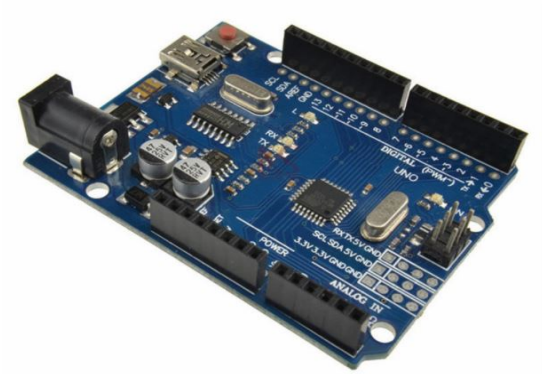

Figure 3.7: Arduino Uno Board [5]

Features:

- Micro controller AT-mega328
- Voltage for operation: 5V
- Voltage at input (recommended): 7-12V
- Voltage input (limits): 6-20V
- I/O digital pins: 14 (out of which 6 pins provide PWM output)
- Input analog Pins: 6
- I/O DC current per pin: 40 mA
- DC Current for 3.3V pin: 50 mA

- Flash Memory: 32 KB of which 0.5 KB used by boot loader
- SRAM: 2 KB (AT-mega328)
- EEPROM: 1 KB (AT-mega328)
- Clock Speed: 16 MHz

LED and LCD: LED of different colours are helpful to indicate the Power On state, Level of Liquid in tank, Working State etc. Since they are low power operated and are helpful to show the status on system board.

Figure 3.8: LED [11]

LCD is Liquid Crystal Display having 16x2 i.e 16 Characters and 2 Row for display the status and system operation mode to the user on system board.

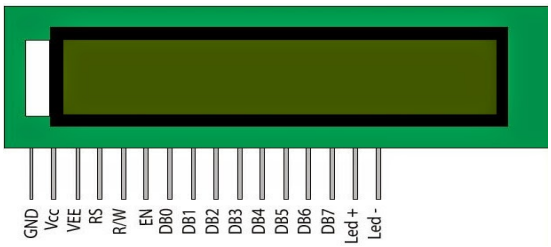

Figure 3.9: LCD Display [11]

Features:

- Support 2.7 to 5.5V, for low power operations
- Liquid crystal display driver power for 3.0V to 11.0V

- MPU interface enable for 4-bit or 8-bit
- Display 80 8-bit RAM (Maximum 80 characters)
- At Power on, the controller/driver automatically reset due to automatic reset circuit
- Internal Oscillator
- Low power consumption

Relay: Relay is same as the switch used for turning On or Off the appliance at home, but this is controlled via the electrical input controlling the current moving through the coil of relay which controls the switching. The easiest way to do this is with a solid state relay (SSR). Relaying the AC current is different task then relaying the DC current. Mechanical relay provide both DC or AC relaying. SSR can only do AC, and will not switch DC current. Connection of an AC load, to a SPDT-Single Pole Double Throw Relay is shown in Figure 3.10 .

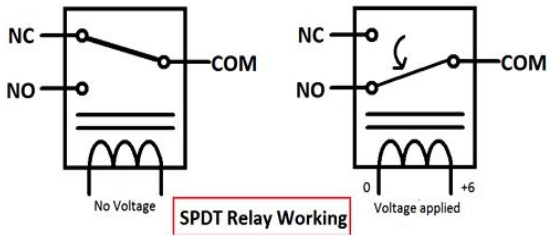

Figure 3.10: SPDT Relay [7]

3.3 NVR and DVR

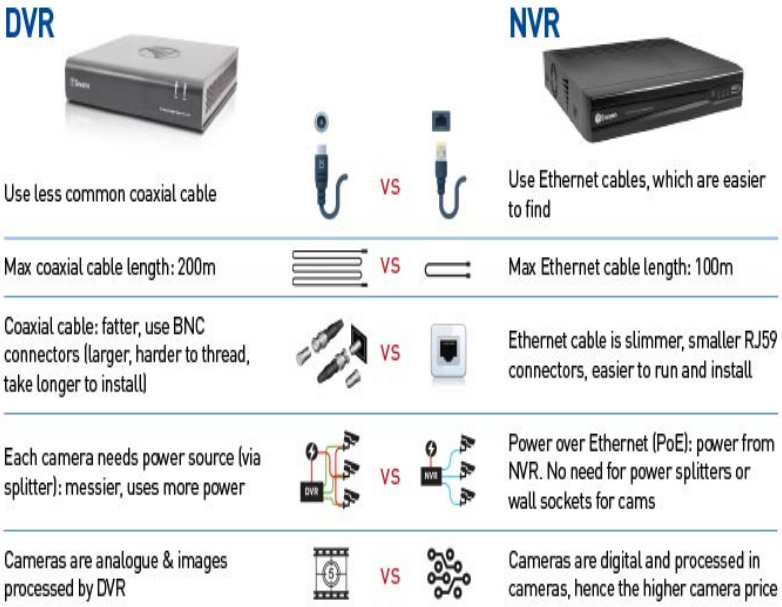

Figure 3.11: DVR vs NVR [7]

Digital Video Recorder and Network Video Recorder are the either of the central monitoring or say controlling device of video surveillance setup. DVR based system makes the cameras connected via co-axial cable mostly. NVR based setup supports the digital IP cameras connection via network cable and power supply cable is required for with NVR without PoE facility. DVR does not require the cameras to be programmed or setup, simple plug and play solution. The back panel of DVR is shown in Figure 3.13, which shows the interface connection ports. NVR requires to configure or setup the IP for cameras like it require for network device. Modern NVR provides auto IP detection for configuration of camera and thus make it easy to setup for user. The NVR back panel for interface connection ports is shown in Figure 3.12 . Depend on the camera type and wiring used the NVR or DVR is deployed. NVR has capability to be configuring the camera for different events and make changes easily and remotely using network connectivity with the

help of VMS software. NVR contains no dedicated hardware for video recording, in DVR based setup system the video encoding and processing is done at DVR, while in NVR based setup system video encoding and processing is done at camera end and then streamed to NVR,and video is stored or live stream depend on setup. NVR allows to be accessed via web browser using VMS software and allows to track the event and notify via email about the events. The encoding is done with the supported technique by video management software and camera manufacturer provided support with different models. Also the frame per second and bit rate settings are provided by most of the VMS software provider and so the configuration is made as per the available storage capacity and the application where the setup is installed. Like for the jewellery shop, bank, museum, the quality has to be high enough to have the clear vision for objects and moments nearby. Because the higher resolution makes the system to provide high processing and bandwidth or storage requirements. The widely and best supported video compression standard is H.264, although there are other techniques but still in down the line may be supported by the hardware. The DVR has the port for coaxial cable connection for the camera. The power supply input port, HDMI and VGA port for monitor output, internet connection LAN port. While NVR has the network connector LAN port for the camera connection as well as network connection. The NVR are of two types either PoE enable or without it. Some model of NVR has the bandwidth control setting available for maintaining the traffic of the network for the main line cameras and other devices. There are video out HDMI or VGA connection port also available. Both have the connection for the audio input and out to record and output the stored audio respectively.

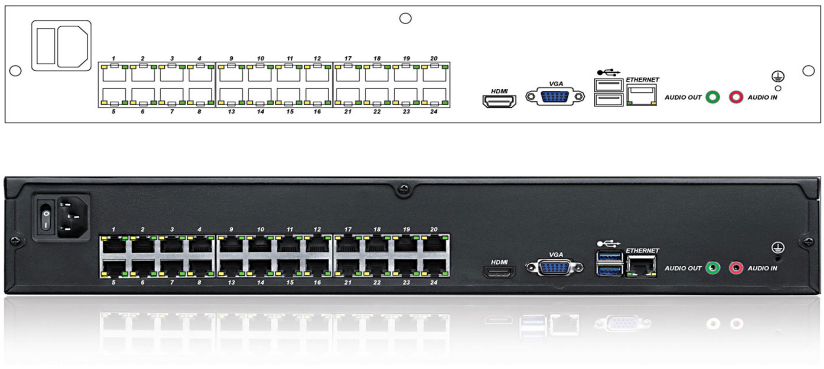

Figure 3.12: NVR-Network Video Recorder [7]

Figure 3.13: DVR-Digital Video Recorder [7]

3.4 Cable and Connection

The camera are connected to the NVR via network cable of Cat 5 Twisted pair. The cable type gives better performance up to 100 MHz, and also has the support for ethernet over twisted pair. The DVR based system widely has the coaxial cable connection for the camera. But the new technology Camera and NVR based system eliminates its use. The RJ45 connector is used at ends to connect one end to NVR and one to camera. The NVR if PoE enable the power is also supplied to camera using same cable. The camera has different connectors available for connection as shown in Figure 3.14 .

The PoE camera is connected via PoE enabled network switch and reduce the

Figure 3.14: Camera Connector ports [9]

extra power supply requirement for the camera, the connection is made as shown in Figure 3.15 .

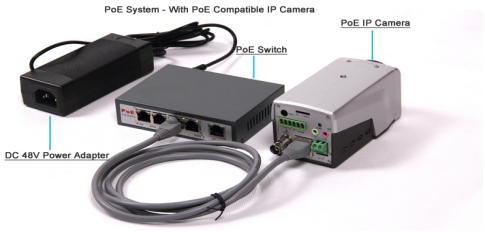

Figure 3.15: PoE Camera Setup [9]

Surveillance Camera Setup: Actual block diagram for the connection of security surveillance system of camera, nvr, router, system and power supply is as shown in Figure 3.16 .

Figure 3.16: Camera Security Surveillance System Setup [9]

Chapter 4

Software Requirements

4.1 Arduino IDE

Arduino Software (IDE- Integrated Development Environment) is the open source tool, it makes it easy to write code and upload it to the board using the IDE. It has support to work on Windows, Mac OS X, and Linux. The environment written in Java, and based on processing and different open source software's available. The IDE software provide support with any arduino board. It has capability to check syntax or program errors when compilation is done. The IDE consists of inbuilt example code for the beginner to start the hands-on practice with arduino board basic coding and thus is very helpful to write a program for arduino uno board. The start up logo of the arduino IDE genuino version is shown in Figure 4.1. The arduino provides the community for the problem reporting and proposed solution by developers or different user of the community. The arduino also has the online web editor facility available.

4.2 Android App

The application to run on the smart phone will be required to be designed using the available open source tool like Android Studio and thus to operate or monitor

Figure 4.1: Arduino IDE start-up [5]

the system using wireless connectivity with the main system having interfaced the Bluetooth HC05 chip.

Other: Further the software to implement the actual hardware design to the PCB design software like Eagle Board etc. will be required to design the PCB for the final system of Home Automation on board.

For testing purpose the app used was Android app Bluetooth Terminal from the Google play store. The Bluetooth terminal application logo is as shown in Figure 4.2 . Further which will be developed by the developer to provide authentication and security access to the Home Automation system.

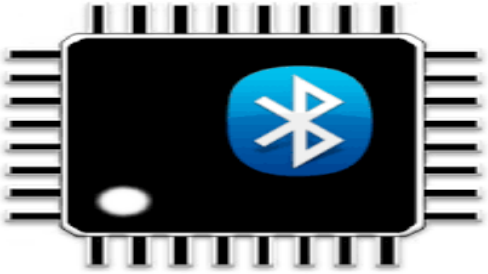

Figure 4.2: Bluetooth Terminal Android App

4.3 IP Discovery Tool

To discover the connected type of camera and verify its IP, the IP discovery tool is required. IP discovery tool is available by the camera manufacturer or can use the freeware available online, but may or may not support for all the make and models of cameras. We used the tool developed by own company for the client manufacturer and send the updated version with optimization and reported threat solutions. The IP discovery tool helps to test the camera for boot operations and firmware version identification.

4.4 Video Management System Software

The VMS software help to view the live streaming video in desired format, and bit rate with facility for multiple video stream window. The VMS software provided is from client of camera brand or freeware. But there are chances that camera features may not support with VMS of other than its own manufacturer. The VMS used by us was from the camera manufacturer only. It provides live video streaming, recording, event scheduling and monitoring and new advanced features upgrade come with new version. Also the features like Audio detection, object motion sensing, human detection using PIR sensor mounted on camera, are available with VMS support. The VMS software is use for camera configuration, firmware upgrade, restore, email notification, notification for tampering attempt, event monitoring, cloud storage configuration. The VMS being most import part for surveillance application is designed with target like number plate detection, video analytic, artificial intelligence for advanced smart search.

Chapter 5

Results and Observations

The study of the different sensors, for the sensing of parameters in the room was carried out. Choose the supporting microcontroller as arduino uno board, which has the features required for the basic testing. Arduino uno board boot up and driver installation on eInfochips desktop. The features to be provided according to the latest facilities in the new infrastructure scheme for premises. Arduino serial port communication using on-board serial port with the TX and RX pin for exchange of information. Interfacing the Bluetooth HC05 module and output device as LED. Perform the hyper terminal output and input operations with HC05 to arduino from android bluetooth terminal app.

Interfacing of Smart Phone with Arduino using Bluetooth communication carried out using the Software Serial inbuilt header in the IDE for the Bluetooth communication was carried out using the Android app Bluetooth Terminal. The led is interfaced to arduino uno on pin 8. The setup is as shown is Figure 5.1 . The mobile application shows the available devices nearby, the HC05 is discovered and click to connect to the module. The discover devices are shown in Figure 5.2 .

- Sending data from Mobile phone android app, results the arduino interfaced led on pin no. 8. The observation is made as below:
  Sending 1 to turn LED On from smart phone app.

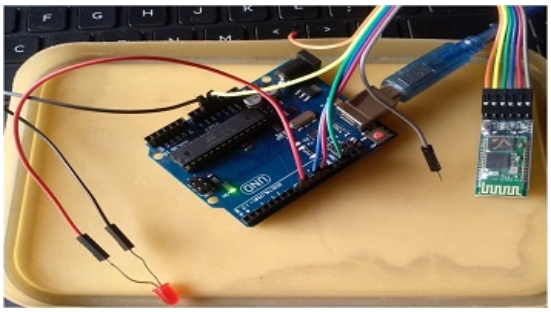

Figure 5.1: Arduino Interface with Bluetooth HC05

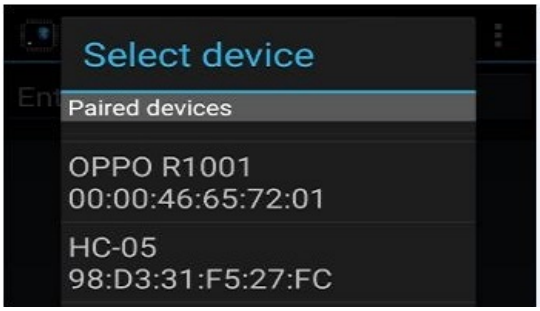

Figure 5.2: Discover the HC05 module on Smart Phone

The android application view is shown in Figure 5.3 . Output for 1 as input is shown in Figure 5.4

Sending 0 to turn LED Off from smart phone app.

The android application view is shown in Figure 5.5 Output for 0 as input is shown in Figure 5.6

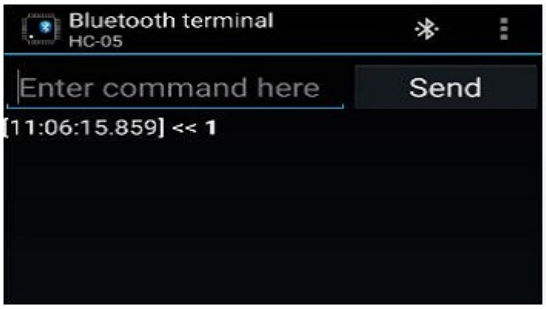

Figure 5.3: Send 1 as input from Smart Phone

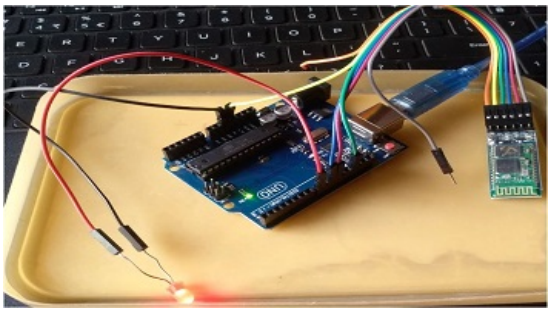

Figure 5.4: Output for 1 as input from Smart Phone

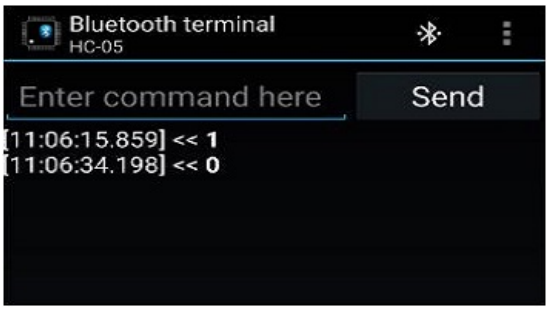

Figure 5.5: Send 0 as input from Smart Phone

Camera Operations: The Camera of different types like Fish-eye, Fixed, PTZ, Bullet type camera understanding and configuration. Firmware upgrade for the new camera using setup software. The task to verify the mentioned features for fixed, dome, PTZ type of cameras was carried out. And the result if found not satisfying, reported to the client for permission to modify the next version of VMS software or state as limitation if not possible to modify. Exploring the camera features for application provided by VMS software:

- **IP Discovery Tool**: The camera when connected in the network, is allotted the unique IP address from the available pool of ip, the static ip can be given if own a private network with static ip allocation. Mostly the auto ip mechanism is used so as to avoid ip conflict. The new camera is discovered using the IP discovery tool, which display the Camera make, model, ip address, and firmware version.

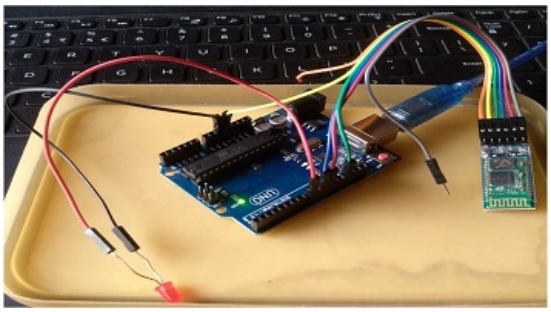

Figure 5.6: Output for 0 as input from Smart Phone

- **Audio Detection**: Detect the event for audio input available near the camera microphone receiver or externally connected microphone.
- **Video Streaming/Recording**: Observe the different video live stream, and record the samples at different interval and verify the stored .mp4 file.
- **Event Scheduling**: The Event scheduled for defined time duration of either audio detection or human detection or motion of object was observed. The camera was configured for each type and obtained the notification via mail.
- **Auto Tracking**: The configuration set for camera keeping in auto track mode made it track the moving object for the defined area under cover by camera.
- **Other**: The camera performance and result obtained were sent for client feedback and also the report the issue found during the process for optimization and improve the stability and support for different camera of different manufacturer. Thus the VMS software development, testing, setup help to improve the capacity of providing support to more number of camera models of different vendors. The recording video with setting for different video encoding formats like H.264 and H.265 and fix resolution and frame per second setting during configuration of cameras.
- Then comparing the results obtained for the camera models and choosing the best of it. The widely and best support technique is H.264 due to its better

encoding performance and supported by most of the cameras and their VMS software. The observation for the 30 minutes video with fix resolution set for 1920x1080 and 30 FPS(Frame per second) fix bit rate of 10 MBPS(Mega Bit per second) for H.264 and H.265 was obtained as H.264 utilized 600MB of storage while H.264 used 280 MB of storage but the highest storage was resulted using the MJPEG technique.

Chapter 6

Conclusion

6.1 Conclusion

We can conclude that the Home Automation using the IoT (Internet of Things), for the automation of light, temperature, water management, window, door and garage door. Also IoT for the smart security surveillance for the monitoring and extracting the useful information of the recorded video for the set premise. Testing of the different camera features for the specific video management software version and explore the available interfaces with camera. The setup of IoT home automation hardware with security surveillance system will be useful to make the full smart home automation available for end user.

6.2 Future Work

- The future work will be to implement the actual hardware interfacing of all the sensors with the micro controller. Actuators and LCD programming interface with Arduino Uno
- The Video management system software optimization and report the issues/threat to client
- The development of the **Android App** for Bluetooth Serial communication with Arduino to control the appliances and monitor the status of the same
- Include the cloud interface for the access to the system via remote location using the internet and include the **AI-Artificial Intelligence** to improve the surveillance and security
- The PCB designing for the final system hardware to be represented as the final product.

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