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DESIGN AND IMPLEMENTATION OF INTEGRATED SMART HOME SYSTEM (ISHS)

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Abstract - *This report proposes a style of integrated home automation system using Robotdyn Mega 2560 PRO Mini based on Internet of Things (IoT). Now days, many home automation devices are present that replace the existing appliances and are feasible only with the smart appliances which may not be beneficial. This project is intended to monitor the surrounding and control the existing appliances with user friendly interface. The consumer can integrate up to 32 devices. It helps in monitoring the environment of the home and provides maximum security and unparalleled user convenience. One time password or one time pin (OTP) is valid for only one login session for the authorised guest user. OTP provides high security than static passwords. A thin-film-transistor liquid-crystal display (TFT LCD) replaces from conventional switches to low voltage switch system which isolates human from high voltages and also provides user friendly interface. This system also interconnects the energy meter to incorporate energy saving activities by the residents. The system also has features such as automatic gas booking and trash management system.*

Key Words: **Android application (App) controlled devices, Home automation system, Internet of Things (IoT), Smart home system, Integrated home system.**

1. INTRODUCTION

As the world travels towards modern systems, the comfort and security of home automation plays vital role in recent days. Many smart devices have been developed to provide control and monitor the environment of home. Most of them are expensive and need a hub to control them. Recent developments include Amazon Alexa, Wink Hub, and Philips Hue. They act as a hub to control and monitor only the smart devices. The paper proposes the design of integrated smart home system which performs tasks automatically and end users experience great convenience. It provides better control functions of gadgets remotely by using android application. This system monitors the power consumption, helping to prevent exorbitant electricity bills. We're living in the golden age of technology development, you need not want to replace the older ones instead you can integrate them with the new technology with increased energy efficiency and improved functionality.

2. LITERATURE SURVEY

The trend in the home automation system is more towards the automation of day to day activities. For the elderly and disabled people who require care, the home automation system can give increased sophistication by adding intelligence to home devices. The smart phones and other devices plays vital role in today's environment due to advancement in technology which allows many devices to interconnect with each other. The research and implementation of internet of things are getting more popular now a days [1]. The research carried describes the network interoperability and control of home devices from remote areas using home networks. These designs include dedicated web server, expandable database and a user friendly web page to manage the smart devices [2]. The Bluetooth is used for communication between mobile phone and the system. The Bluetooth is used for short range communication and internet is not used for remote control process. This system can be controlled only when the users are in the range of Bluetooth [3]. A high end personnel computer is required which increases cost of installation as well as energy consumption. The GSM based communication is used in the system which requires AT commands. The GSM communication is slow operation and is not suitable for controlling and monitoring the home devices [4]. A graphical representation of sensor reading is displayed in web servers provide better way to monitor the environment. The system includes Wi-Fi communication hence the appliances can be controlled from any part of the world. This system is not suitable since open source web server is used and hence there is a fall in security. The system is designed with the help of arduino uno microcontroller hence the scalability is not possible [5]. The recent development in smart home devices and mobile IP applications are described which uses the principle of MIPv6 for providing mobility on the design of MIP based home automation system. A home gateway is used as a service gateway which communicates between different protocols for appliances [6]. The communication between arduino board and mobile phone is by Bluetooth technology which is wireless. Password protection is used to provide authorized control of devices. The Bluetooth technology can be used for local control of appliances and it is not scalable since large scalable communication such as GSM or IoT is not utilized. This technology is not encouraged by the users since

it can be used for only local operations and not for remote operations [7]. The communication takes by a telephone line hence the wired communication involves lot of noise and installation cost is increased which becomes the disadvantage of the system [8].

3. EXISTING SYSTEM

The currently existing system smart home system (SHS) do not provide any trash management, gas booking, and an OTP generated entry of unknown people. Most of the existing system does not provide constant speed when more than 4 interrupt devices are integrated instead the speed gets reduced as well as system gets crashes. Existing systems provide security management, trash management, monitoring system and metering system separately and not integrated. Any system that needs to be integrated is designed for that particular hub. Hub such as Philips Hue, Amazon Alexa and Wink Hub can integrate the smart devices designed on the basis of them. It does not able to control the appliances which does not support Wi-Fi control. The existing system fails to operate when internet shutdown occurs and requires many terminals and switches that a far from each devices to control.

4. PROPOSED SYSTEM

The Integrated Smart Home System (ISHS) mainly focus on controlling and monitoring the appliances that is connected to the system. The system can be controlled both via android application as well as touch screen present in the house. The touch screen control provides isolation from high voltage controlling operations. Some devices such as safety lockers can be controlled only from android application ensuring high security to the house. It also provides high secured door locking system by using biometric system. The system can be used by residents as well as the persons authorised by the residents. The authorised persons can enter into the house by using OTP generated from the security system that is acknowledged by the residents of the house. The system is designed by Proteus Professional and Arduino IDE. The android application provides user friendly interface for the remote operations. The TFT Screen helps when the server can't be reached. The security cameras will provide visual image through the android application for the residents. The proposed system consists of subsystems that communicate with one another by using MQTT cloud server.

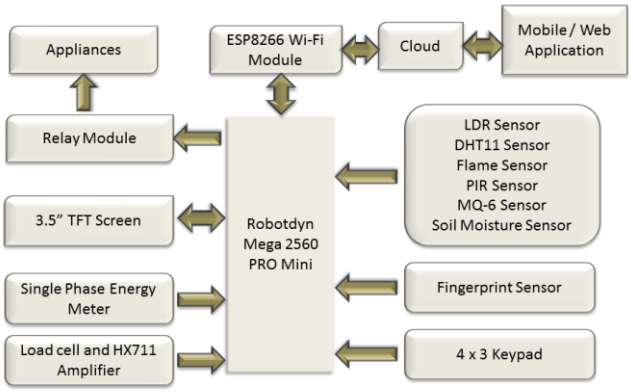

Fig -1: Block Diagram of Integrated Smart Home System

4.1 MQ-6 Sensor

The MQ-6 sensor has high sensitivity to LPG, isobutene and propane, used as a gas leakage detection system in ISHS. When the leakage is detected the electricity will be cut-off immediately to avoid more damage to the home. The output of the sensor is manipulated by the microcontroller and the data is sent to cloud for further processing such as alerting residents of the house.

Fig -2: MQ-6 Sensor

4.2 DHT11 Sensor

The DHT 11 temperature and humidity sensor is used to monitor the temperature and humidity inside the room. During summer the day becomes so hot so that AC can be turned on before reaching the home and runs till the desired temperature is reached. The temperature range for DHT 11 sensor is 0°C to 50°C and the humidity range is 20% to 90%. The resolution both for temperature and humidity are 16-bit and accuracy is ±1°C and ±1%.

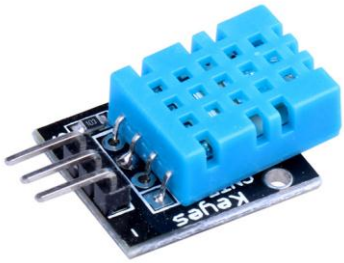

Fig -3: DHT11 Sensor

4.3 Flame Sensor

The flame sensor can detect flame with wavelengths ranging from 760 nm to 1100 nm. This is used to trigger the fire alarm and sprinkler system. The degree of heat is computed from the sensor and is manipulated by the microcontroller, data is sent to the MQTT broker which alerts the residents and fire station about the degree of heat so that necessary tools can be brought.

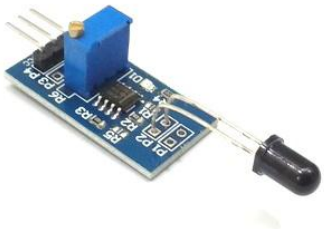

Fig -4: Flame Sensor

4.4 Soil Moisture Sensor

The soil moisture sensor measurement ranges from 5% moisture to fully saturated soil. It helps to water the plants. The value of the soil moisture sensor is used to water the crops based on their amount they consume so that water wastage can be reduced. It also helps to prevent the wilting and dying of plant in summer heat.

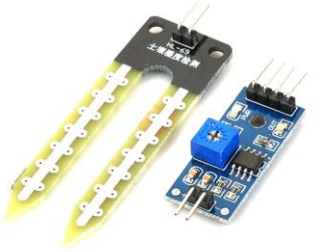

Fig -5: Soil Moisture Sensor

4.5 PIR Sensor

The Passive Infrared sensor helps to sense motion, used to detect whether a human has entered or left out of the sensor range and turns on/off the lights and fans in the particular room. The PIR sensor helps in saving the electricity by turning off the relay system of the room. The PIR sensor is a dual element sensor with low noise and high sensitivity. It has a delay time adjustable switch so that the light can be turned on for a particular time after when we go out of the room.

Fig -6: PIR Sensor

4.6 LDR Sensor

The Light Dependent Resistor is used in automatic lighting control. The cell resistance of LDR 4009 will be in range of few ohms to few kilo ohms. The LDR sensor value is taken by the controller and the PWM signal is generated by the controller is used to adjust the intensity of light. The change in resistance value of the LDR sensor implies the value of intensity of light is suitable.

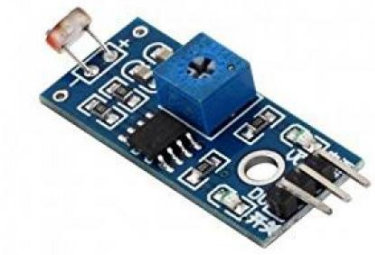

Fig -7: LDR Sensor

4.7 Fingerprint Sensor

The R307 Optical Fingerprint Reader Sensor Module consists of high-speed DSP processor, used for independent fingerprint collection, registration, comparison and fingerprint search functions. It is used to unlock the doors by the residents. The biometric system recognizes the residents of the house and the data is sent to the controller. The data is manipulated by the controller and is stored in the database which can be viewed in the android application.

Fig -8: Fingerprint Sensor

4.8 4X3 KEYPAD

The keypad used to enter the one time password (OTP) generated by the Mega 2560 PRO mini. This is used by the guest to enter into the house with prior permission by the residents of the home. The OTP entry adds high security to the house since the code can be used only one time to enter into the house.

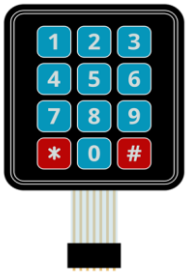

Fig -9: 4x3 Keypad

4.9 Robotdyn Mega 2560 PRO

The heart of the system is the microcontroller, used to get the data and process it. The processed data is sent to the MQTT cloud. The board has compact size 38x52mm and has 54 digital I/O pins and 16 analog I/O pins. The Mega Pro MINI CH340G / ATmega2560 board is based on the ATmega2560 microcontroller and the USB-UART adapter CH340.

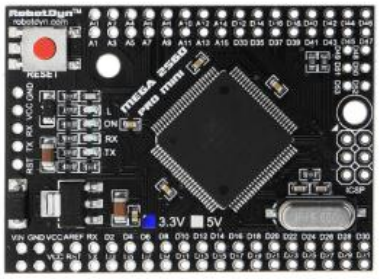

Fig -10: Robotdyn Mega 2560 PRO

4.10 Nodemcu

The data from the MQTT cloud can be obtained and manipulated with the help of Nodemcu, which has ESP8266 Wi-Fi module with it. The Nodemcu also sends the sensor values to the MQTT cloud. It is an open source IoT platform, includes firmware which is based on the ESP-12 module. NodeMCU has ESP-12 based serial Wi-Fi integrated on board to provide GPIO, PWM, ADC, I2C and 1-WIRE resources easily.

Fig -11: Nodemcu

4.11 3.5" TFT Screen

The Thin Film Transistor LCD used to provide easy mode for viewing data from the sensor and control of appliances. It also isolates the human from the high voltage switching operations. It also provides user friendly interface to the human. The TFT screen can be helpful to control the appliances when there is a network breakdown.

Fig -12: 3.5" TFT Screen

4.12 Load Cell AND HX 711 ADC

The 24 high precision A/D converter chip HX711 helps in converting the analogue value from the load cell into digital value. This is used to know the exact weight of the gas cylinder hence the booking can be done in advance. This is also used to determine the amount of waste that is produced in the home so that the waste can be reduced by the residents. The pollutants such as plastics are disposed by paying amount to the government and bio degradable waste can be used as a raw material for fertilizer production hence the government will pay for the bio degradable waste.

Fig -13: Load Cell AND HX 711 ADC

4.13 Single Phase Energy Meter

The pulse of the single phase energy meter can be used to determine the load consumption by the connected devices of the home, which can be used to save the electricity. The call signal from the energy meter can be used to calculate the units consumed by the user. The data is directly sent to the Electricity board and also is displayed in mobile application for consumers to save the electricity.

Fig -14: Single Phase Energy Meter

5. RESULTS AND DISCUSSION

The ISHS hardware is designed and developed by using Proteus Professional and Arduino IDE. The web server used is 000webhostapp and the database used is phpMyAdmin. The integrated smart home system has three systems. They are

i) Monitoring system
ii) Metering system
iii) Management system

5.1 Monitoring system

The monitoring system includes Robodyn Mega 2560 pro mini and various sensors interfaced with it. The sensors such as DHT 11 temperature and humidity sensor,MQ-6 sensor, soil moisture sensor, flame sensor, PIR sensor and LDR sensor is used for monitoring the environment of the home. The TFT screen is used to provide user friendly interface. The appliances can be controlled using TFT screen also.

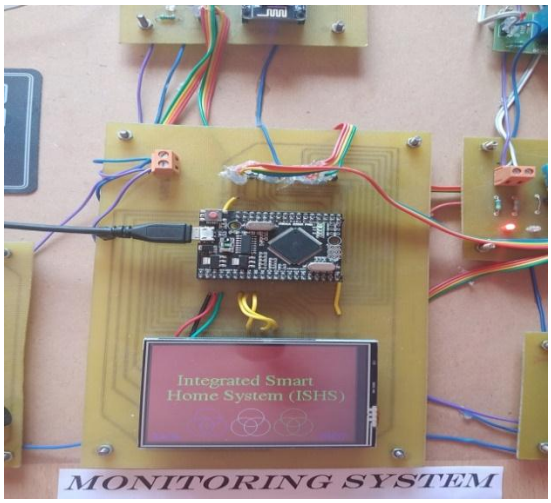

Fig -15: Monitoring System

5.2 Metering system

The metering system includes nodemcu microcontroller which has an ESP8266 Wi-Fi module. The units are calculated by using call signal from the energy meter. Since the nodemcu has Wi-Fi module the data is sent to the MQTT cloud.

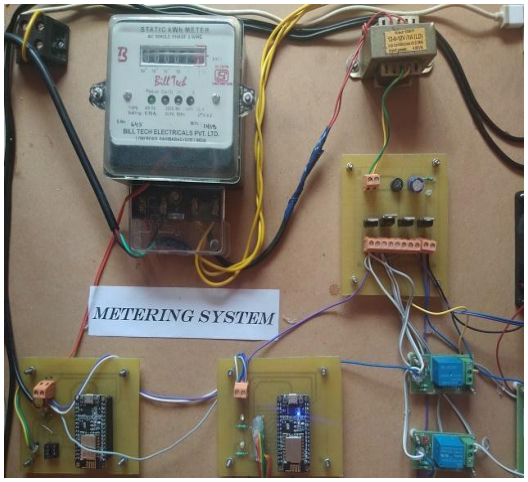

Fig -16: Metering System

5.2 Management system

The management system includes trash management, security management and gas cylinder management systems. The trash management includes 10 kg Load cell and HX711 module. The amount of wastage produced is calculated and viewed in the mobile application. The gas cylinder management system includes 20 kg Load cell and HX711 module which is used to obtain the weight of the gas cylinder so that automatic booking can be done. The security system has R307 Fingerprint sensor and 4x3 keypad which provides high secured authentication for both residents as well as authorized persons by the residents of the house.

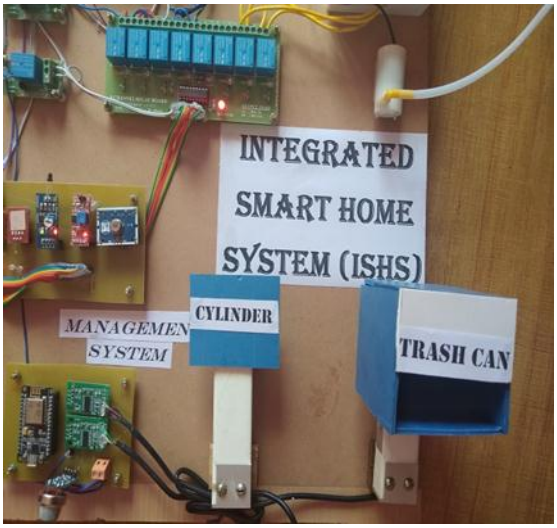

Fig -17: Management System

5.4 Mobile Application

Mobile app was created using Ionic framework which is a native script uses angular 2. Ionic framework is an open source UI toolkit for building high performance mobile application using web technologies (HTML, CSS and TS). Ionic framework mainly focuses on UI interaction for that it uses Angular 2.It also have large library which support many features. The main advantage of Ionic is its cross platform feature. Ionic app can be built as both native ios and android app with single codebase. It is the main reason for choosing ionic to build app in our project.

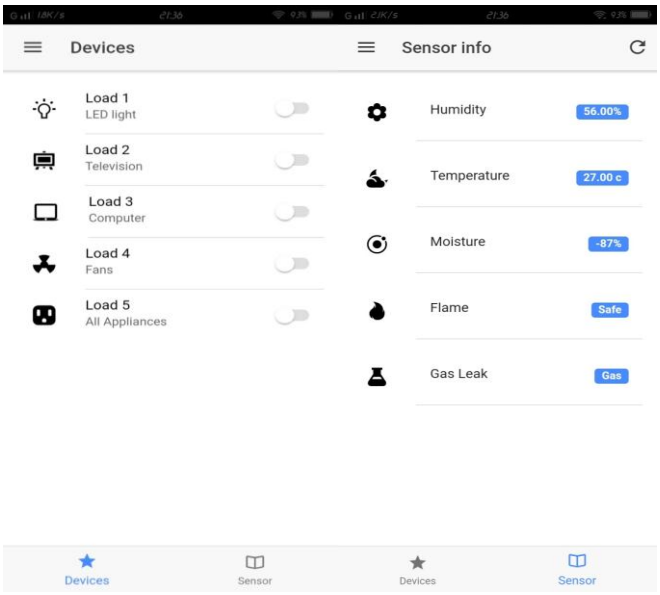

Fig -18: Android application (ISHS)

5.4 Web Application

Web app was created using JavaScript which is an native script uses Paho MQTT. It is hosted using GIT repositories. Github is an open source software developing platform, which accepts languages like HTML, CSS and JS. Web app communicate to micro controllers through a communication protocol called MQTT. MQTT broker pays a way through which data can be sent and received across Web app and micro controller. In order to increase the security of the Web app, Sign in and Sign up page is included so only authorized user can login. During login, if the user credentials are valid then the user would be able to move to the controlling page. On every further request made to the backend server the token is send along the request URL. If the token is valid then corresponding response is send to the Web application.

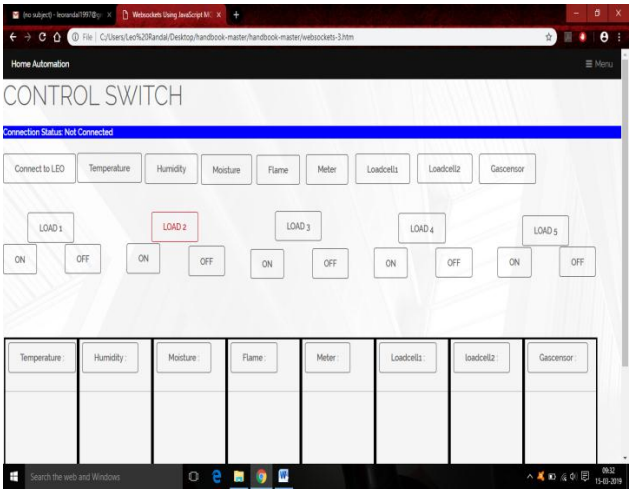

Fig -19: Web application (ISHS)

6. CONCLUSION

The proposed work is an integrated smart home system (ISHS), which is mainly focus on existing systems that can be integrated to become a smart system. ISHS is used to monitor our appliances both through mobile application and web server doesn't matter how long the distance may be. This helps us to manage our electricity bills, makes gas booking on its own, and helps us keep track of the amount of plastics used. It also helps in safeguarding our home from unknown persons. The processor used can maintain the constant speed even when much number of devices is connected to it. The maximum numbers of devices that can be connected to a single system are 32.

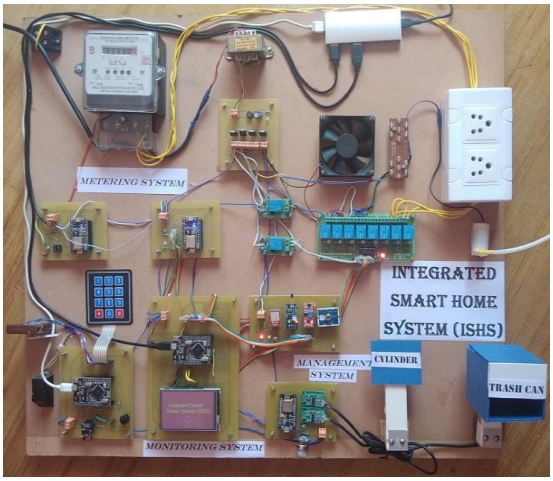

Fig -19: Integrated Smart Home System (ISHS)

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REFERENCES

[1] Y. Liu, "Study on Smart Home System Based on Internet of Things Technology," in Informatics and Management Science IV. vol. 207, W. Du, Ed., ed: Springer London, 2013, pp. 73-81.

[2] A.Z. Alkar and U. Buhur, "An Internet based wireless home automation system for multifunctional devices," Consumer Electronics, IEEE Transactions on, vol.51, 2005, pp.1169-1174.

[3] C. Chiu-Chiao, H. Ching Yuan, W. Shiau-Chin, and L. Cheng-Min, "Bluetooth-Based Android Interactive Applications for Smart Living," in Innovations in Bio-inspired Computing and Applications (IBICA), 2011 Second International Conference on, 2011, pp. 309-312.

[4] R. Shahriyar, E. Hoque, S. Sohan, I. Naim, M. M. Akbar, and M. K. Khan, "Remote controlling of home appliances using mobile telephony," International Journal of Smart Home, vol. 2, pp. 37-54, 2008.

[5] A. ElShafee and K. A. Hamed, "Design and Implementation of a WiFi Based Home Automation System," World Academy of Science, Engineering and Technology, pp. 2177-2180, 2012.

[6] B. Park, "Mobile IP-Based Architecture for Smart Homes," International Journal of Smart Home, vol. 6, pp. 29-36, 2012 [6] A. Kamilaris, V. Trifa, and A. Pitsillides, "HomeWeb: An application framework for Web-based smart homes," in Telecommunications (ICT), 2011 18th International Conference on, 2011, pp. 134-139.

[7] R. Piyare and M. Tazil, "Bluetooth Based Home Automation System Using Cell Phone," in Consumer Electronics (ISCE), 2011 IEEE 15th International Symposium on, 2011, pp. 192-195.

[8] P. Lin and H. Broberg, "HVAC Applications". IEEE Industry Applications Magazine, pp.49-54, January 2002.