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Smart and Intelligent Home

Prof. Vijaylakshmi V[1], Jeevitha J[2], Likitha S[3]

[1] *Assistant Professor, Department of Information Science & Engineering, Atria Institute of Technology, Bangalore, India.*
[2,3] *Student, Department of Information Science & Engineering, Atria Institute of Technology, Bangalore, India.*

Abstract - *In places like home and office, electronic appliances such as light and fan are manually operated, where there is lot of power consumption and wastage. Though they are not used they are left ON and when the appliances are used their functionalities are not dependent on environmental factors such as temperature changes and sunlight. Making the electronic appliances smart and automatically control, we possibly achieve energy conservation. Our paper aims to give, home automation and security system design using ARM7 LPC2148 microcontroller. All the home appliances interfaced with the ARM7 microcontroller and are made to communicate with the ARM7 and the sensors. The proposed system consists of an electronic door with biometric locking system and a module which helps saving the power consumption. As soon as the input users finger print matches in door lock, the power saving module is switched ON. The model which saves the power will operate the appliances within the room only if there is any person in the room. Additionally, it also controls the amount of power which goes to light and fan based on factors like temperature and light intensity.*

Key Words: **IoT, Home Automation, Face Recognition, ARM LPC2184, Finger Print, Password, Gas Sensor, Temperature Sensor, Fire Sensor.**

1. INTRODUCTION

Home automation is the automation for a home, which helps the individuals of the house to protect their home from any wrong authorization and provide security to the house in their absence.

This paper presents you with the highly sophisticated automatic system for monitoring the such as alarm, temperature, gas leakage, fire and various tasks which are monitored by the computer. In our project we have used the ARM microcontroller to connect all the automation devices to efficiently work incase of emergency conditions. This is an IoT based technology which is used to monitor the working of the house.

We have also equipped the house for security purpose using the open-cv for face recognition technique to prevent any unauthorized access inside the house when the house owners are not there in the house. This system recognizes the face of the person and sends a message to the owner about the activity and the owner can take the necessary measures later. This paper also contains the other automation devices like sensors which we have used to control the house automatically without manual intervention. We have used sensors like gas sensor and fire sensor to detect if there is any gas or fire leakage in the house and also take the necessary actions. So this project of ours solves the security problems and make life easy for people to live.

2. LITERATURE SURVEY

Taewan Kim, Hyungsoo Park, Sang Hoon Hong, Yunmo Chung proposed a paper on Integrated system of face recognition and sound localization for a smart door phone and published in the year 2013. This paper propose a face recognition and sound localization system which uses door phone to identify the face of the person at the door. It informs the person at the door to adjust his face to the

camera and try to capture the face and check if the person is authorized or not. The door phone used here uses the voice source to turn the camera to project on the face of the person and capture his face. This system is designed with FPGA chip and tested for accuracy.

Xiong Yaohua, Luo Wei proposed a paper on the Smart Home System Based on ARM Platform and published in the year 2018. This paper is proposed on the IoT technology for speech recognition, GSM, sensors and camera. It is based on the ARM platform and all the devices are connected to the ARM microcontroller.

ShopanDey, Ayon Roy, Sandip Das proposed a paper on Home automation using IoT and published in the year 2016. This paper proposes a home system using smart phone and computer. The IoT devices are connected to the automation system and these devices are in turn connected to the cloud server which is handled by the house owner. This IoT system will use the mobile devices to control and access the appliances from any remote location using the internet.

Mile Mrinal, Mashayak Saniya, A.B. Gavali, Lakade Priyanka, Katkar Poonamhave written a paper on Smart Home – Automation and security system based on sensing mechanism in the year 2017. Current generation life runs over the concept called automation as the things which are automated is said to belong to the next generation as they do not require human intervention for their working. The home automation technology gives the user the ability the control the home appliances from any part of the world. The existing system allowed the user to control door locking and unlocking and sensing parameters like temperature, humidity, and light intensity. The proposed system was designed to control the home appliances using Wi-Fi as connection protocol and included functionalities like locking system with alarm, mosquito sensing system and smart water tanks.

Nivedhitha, A.P. Padmavathy, U.S. Susaritha, M Ganesh Madhan have written a paper on Development of Multipurpose Gas Leakage and Fire Detector with Alarm System in the year 2018. In the present days there are lot of domestic accidents occurring due to leakage of gas leading to the fire accidents. This paper focuses on the implementation of an electronic system which detects gas leakage and smoke in case of fire accidents. When the concentration of gas and flames are more the system automatically switches on the relay and the relay which control the electronic unit of the entire home. The relay also gives an alarm to indicate the existence of the accident. The proposed system is better than the existing system in terms of battery power usage, and it's a stand alone system which do not require any human interference.

3. METHODOLOGY

We are using the face recognition technique for extracting the face of the person at the door and see if he is an authorized person or not. To do this we are using face recognition using open-cv. This can be used to track and detect the face from video and camera. We will study deeply about the face recognition using open-cv. Face detection is the most popular technique where it detects human faces in digital images.

The primary step in the study of face recognition is the localization of human face. Localization is known as extracting facial features from using pattern recognition. Open-cv is used for creating such systems. Open-cv uses c/c++ library functions which directly provides machine level code and helps in faster execution of the program. Any device which runs C can run open-cv. Open-cv is free of cost hence we use open-cv for face recognition.

Face recognition has three basic steps which is face detection, feature extraction and face recognition. The skin color, skin tone are recognised as face features. The face

extraction is known as taking of features of the face from the camera. We are using the Haar cascade algorithm for face recognition. Haar Cascade algorithm uses the image subtraction morphology. The algorithm records the cascades of different people and stores in the database. The white region is being subtracted from the black region. This subtraction is performed on each and every image and but might not give the accurate results. The selected images are those with the least error. All the images added together is the weak classifier and the addition of weak classifier is the strong classifier. This process is already present in the set of trainers in open-cv, but we can also create self cascade by applying the code on the compiler. In our project the face image is captured and compared with the images stored in the database, if there is a match then the door of the house is opened and allows the person inside the house, if the image does not match then a message is sent to the owner of the house.

3.1 Fire Sensor

Fire accidents are the most dangerous events that can possibly occur at home. Earlier detection of such accidents can help us save a lot of destruction that might happen in terms of lives and properties. The basic function of a fire sensor is to detect the fire and notify the occupants of the house in terms of emergency and as a reflex action the water pump of the house is turned ON. The fire sensors are known to utilize optical technologies to detect flames which comes during fire accident . The flames emit electromagnetic radiations in infrared ,visible light and ultraviolet wavelengths depending on the source of fuel.

In this paper we are interfacing the 3-pin fire sensor with ARMLPC2148 microcontroller. Fire Sensor can detect fire which has the wavelength of range 760nm to 1100nm. The fire sensor consists of IR sensor which detects the presence of fire and an amplifier circuit. The sensitivity of the fire sensor can be varied accordingly to the system requirement. The ARMLPC2148 microcontroller is programmed to control the water pump when ever the fire sensor detects any sort of fire.

3.2 Gas Sensor

The atmosphere consists of plenty of gases in it. There are different sensors to measure different gases. Our aim is to detect the presence of LPG gas and for this we are using the MQ-2 sensor which is a metal oxide sensor. The MQ-2 sensor basically senses gases like methane, butane, LPG and smoke. The gas sensor detects the concentration of LPG within the room and performs necessary actions. Depending on the concentration of LPG the sensor produces necessary difference in the potential and changes the resistance of the sensor.

The carbon monoxide comes in contact with the sensor and reduces the resistance which can be called as output voltage. Based on this voltage the LPG is detected. Each time the sensor detects LPG the message is sent to the LED module which basically prints the message telling gas detected. The concentration of gas is measured in parts per million.

The sensory modules are combined with comparators and these comparators are set with threshold value so once the concentration of LPG goes beyond the threshold value the digital pin of the ARM goes high and the LED displays the message “LPG Detected”. The threshold for this system is set to 100ppm. The ability of the gas sensor to detect gas depends on chemiresister to conduct current. The gas sensor is interfaced with the ARMLPC 2148 microcontroller and it is programmed to control the exhaust fan once the concentration of the LPG reaches beyond the threshold that is 100ppm.

3.3 Temperature Sensor

The thermistor is a temperature-sensing device in which resistance changes with temperature. Thermistors, are made from semiconductor materials. NTC Negative

temperature coefficient is one type of thermistor and PTC positive temperature coefficient is another type of thermistor. In NTC thermistor as temperature increases, the resistance decreases. Conversely when temperature decreases the resistance increases. This type is the most used type of resistor. A thermistor does not read the data or temperature, instead the temperature changes with the resistor. The value of change in resistance depends on the value of the resistor. The temperature sensor measurement depends upon the hotness and coolness of the object. The working of the sensors is the voltage that reads from the diode. There is a temperature rise if voltage increases and there is a voltage drop between the transistor terminals of base & emitter, which are recorded by the sensors. The analog signal is generated by the device and is directly proportional to the temperature if the difference in voltage is amplified.

3.4 LDR Sensor

It is a device where electromagnetic radiation is a function of resistivity. Hence, they are light-sensitive devices. LDR's also called as photoconductors, photoconductive cells or simply photocells. LDR's are semiconductor materials which are made up of high resistance. Photoresistors works based on the principle of photoconductivity. Photoconductivity is an optical phenomenon. When the light is absorbed by the material its conductivity is increased. The electrons in the valence band of the semiconductor material are excited to the conduction band when light falls on it. These photons in the incident light should have energy greater than the band gap of the semiconductor material to make the electrons jump from the valence band to the conduction band. When the circuit is closed more and more current starts flowing through the device and hence the resistance of the device has been decreased.

4. IMPLEMENTATION

The proposed system employs two types of biometrics mechanism that is face recognition technology and fingerprint technology and a password lock system for authentication.

4.1 Face Recognition Technology

The face recognition system works based on extracting the features that are dominating in human face, stores in the database and performs mathematical calculations. So, when a new user's face is fed to the system for recognizing it extracts the main features and computes the distance between given input face and stored face.

The face recognition module has 3 sub modules:

1. Database creation module: This module initializes the camera first, takes user Id as input then detects the face and converts the given image into grey scale image. Finally, the grey scale image is stored in the database up to 100 frames.

2. Training module: The training module initializes the LBPH recognizer and then gets the face images and the ID's from the database folder in order to train the LBPH recognizer. Finally saves the trained information or data as xml or yml file.

3. Testing module: The testing module loads the LBPH face recognizer ,Haar classifier and the trained data file. Next it captures the face using camera and a open cv and detects the face and recognizes using the mentioned recognizers.

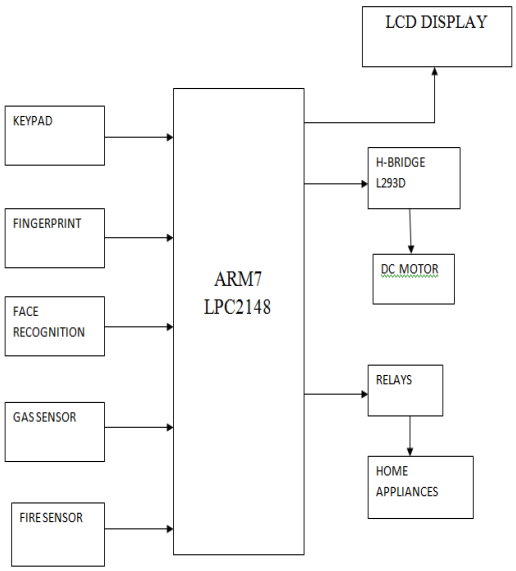

Fig -1: Architecture Diagram

4.2 Haar Cascade Algorithm

In this algorithm, each feature is represented in the form of single values which is obtained by the difference in the sum of pixels in white and black rectangle. In this we also perform image processing where the image is further processed to obtain detailed features. The Haas cascade algorithm is robust, faster and recognizes faces and non faces. We use open cv to capture the image which is basically a library of programming functions which aims to obtain real-time computer vision.

4.3 Finger Print Recognition Technology

The finger print recognition system includes 2 steps: Enrolment and Matching. During the enrolment phase, the user needs to place his finger twice for the system to process the finger prints and to generate the template. The generated template is stored in the database for further matching. During the matching phase, the user scans his fingerprint on a optical sensor and the system generates a new template for the current finger print and matches it with the fingerprint library. In 1:1 matching, the system will match the live fingerprint with a specific template where as in 1:N matching, the system will match with the entire fingerprint library. In both scenarios, the system returns the matching result either its success or failure.

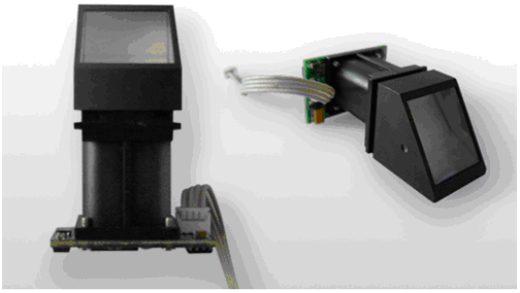

Fig -2: Finger Print Detector

4.4 Password Lock System

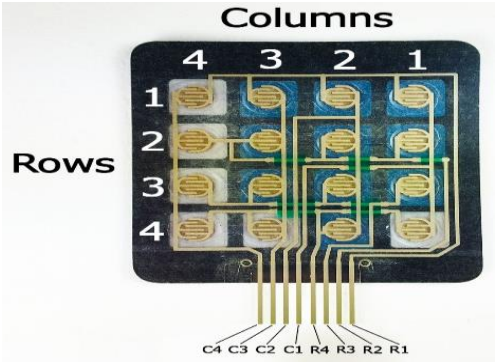

Fig -3: Password System

The 4*4 keypad consists of 16 pushbuttons which are built in and are connected to row and column lines. The ARM microcontroller can scans these lines to check the button-pressed state. In the keypad library, the propeller function sets all the columns and rows line to input. It then sets one of the rows as high. Once all the 3 authentication methods are successful, then the home automation takes place where the sensors and the ARM micro controller control all the home appliances. The different sensors used for automation are temperature, light, gas and fire.

4.5 ARM LPC 2148

ARM 7 is the most widely used arm family which is used to program embedded applications. In this project, the ARM

microcontroller is programmed to control different home appliances based on the sensory information.

4.6 LM35 Temperature Sensor

The LM 35 series are one of the precise integrated-circuit temperature sensors. The output voltage of these sensors are linearly proportional to the temperature of the environment in centigrade. The output of the sensor is converted to analogue signal and as the result fan gets turned on when the temperature goes beyond threshold that is 34degree Celsius.

The diagram shows how the ARM controller is interfaced with LM 35 temperature sensor.

The third pin of the sensor is connected to the GND of ARM, first pin of sensor is connected to VCC of ARM and the second pin of sensor is connected to the input of ARM. We use single female to female pin to connect the leading pins of the LM35 sensor and when the sensor measures the temperature the reading is given to the controller. The ARM microcontroller uses ADC pin to get the reading from the temperature sensor and the output temperature along with the message "More Temperature in Home" is displayed on the LED as a result fan is turned on through the relay driver circuit connected pin no P0.30.

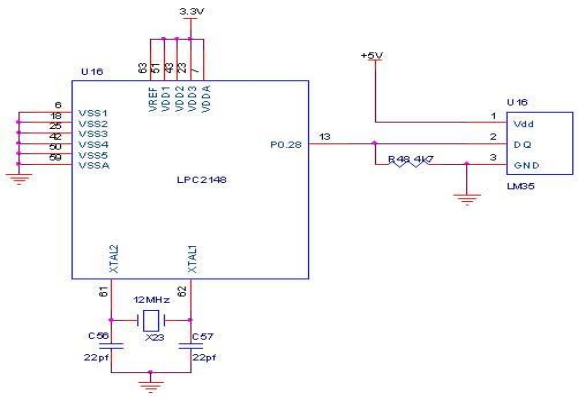

Fig -4: Temperature sensor interfaced with ARM.

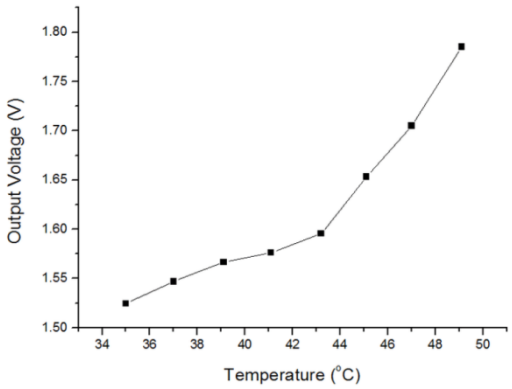

Chart -1: Temperature Sensor Graph

4.7 Fire or Flame Sensor

In the project we are using a 3-pin flame sensor which detects the presence of any fire accidents. We basically use IR sensor to detect the presence of fire, the IR module is interfaced with the controller. If the output of the sensor is LOW then there is presence of fire and if the output is high then there is no fire.

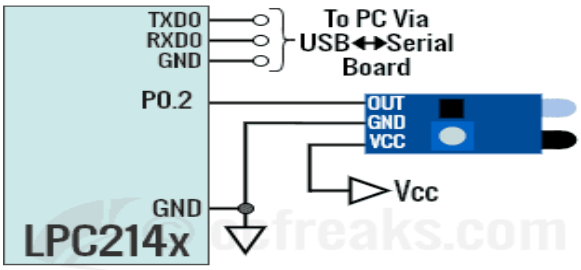

Fig -5: Fire Sensor interfaced with ARM

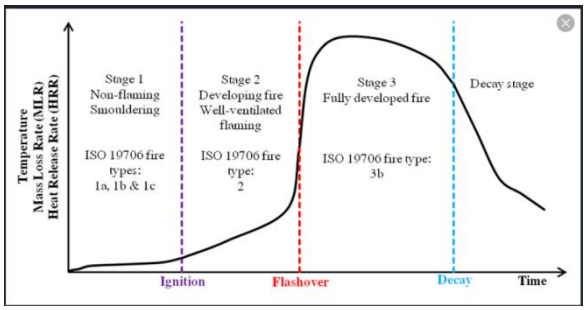

Chart -2: Fire Sensor Graph

4.8 LDR Sensor

The Light Dependent Resistor is basically used to determine the intensity of light within a specified region. They mainly work on the principle of photo conductivity.

The resistance of the LDR sensor is the function of intensity of light as they are inversely proportional. In darkness the resistance ranges from 500K to 5M ohms and in normal lighting it may range from 2K to 10K ohms.

We cannot directly interface LDR sensor along with the ARM controller ADC input, hence we need to convert the resistance to equivalent voltage. This conversion can be done by adding another resistor in series which acts as a voltage divider.

The voltage divider output changes as the intensity of the light changes. The ADC pin of the controller converts the input voltage into values ranging from 0 to 1023. The value 0 means that the specific region is dark and the value 1023 means that the region is very bright. The unit of LDR is luminous flux. The ARM is programmed to turn on the bulb when LDR gives 0 lux reading.

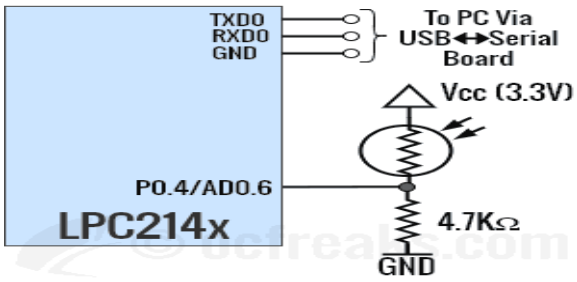

Fig -6: LDR Sensor interfaced with ARM

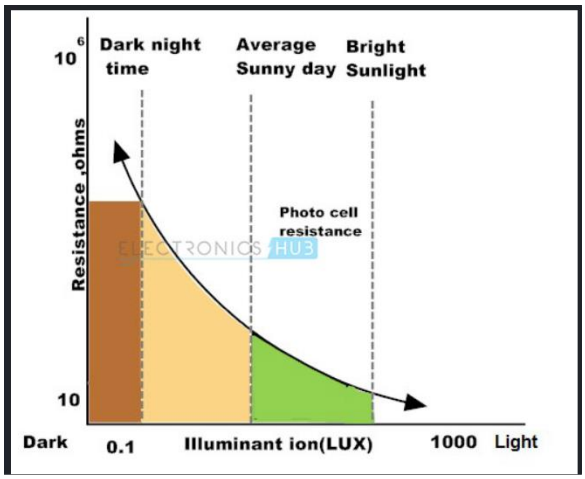

Chart -3: LDR Sensor Graph

4.9 Gas/MQ-2 Sensor

The MQ-2 sensor is used to detect the leakage of LPG gases. It mainly detects gases like carbon-monoxide, methane, i-butane, propane, alcohol, hydrogen etc.

The MQ-2 sensor has both analog and digital output. When the gas sensor comes in contact with the LGP or any other flammable gas its resistance will automatically drop. As the resistance decreases there is more flow of current as a result the voltage across is also increased. As the concentration of gas increases the voltage of the sensor also increases.

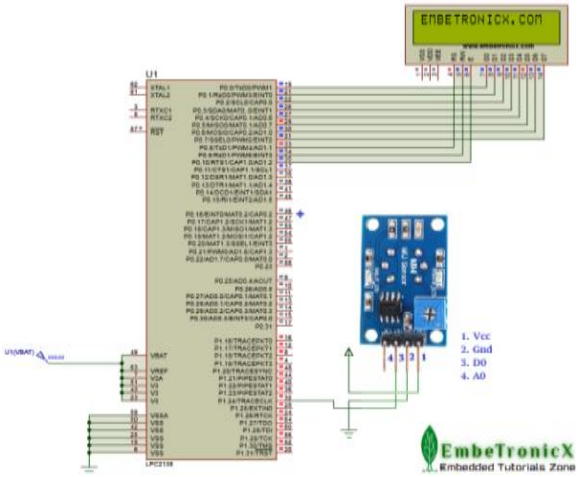

Fig -7: Gas Sensor interfaced with ARM

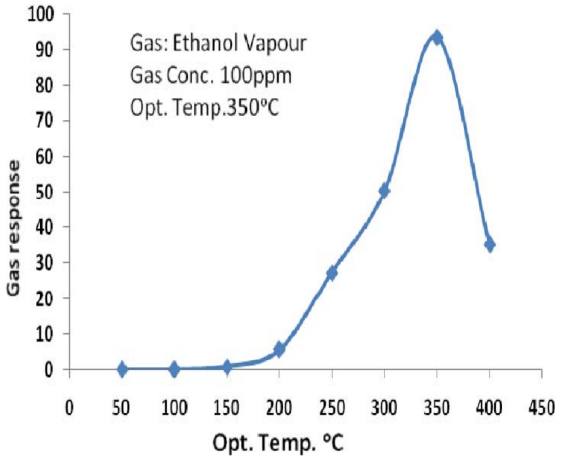

Chart -4: Gas Sensor Graph

4.10 Final Output Graph

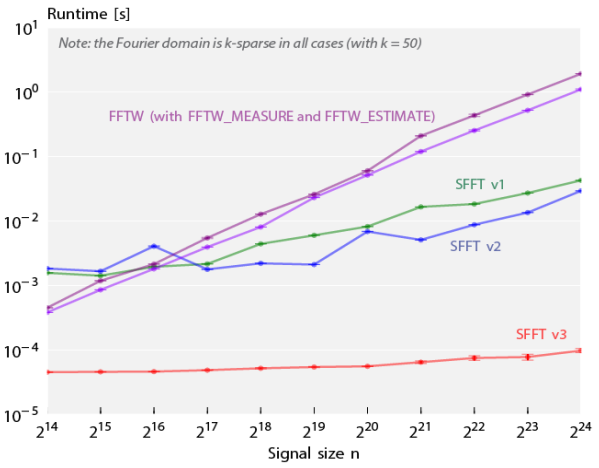

Chart -5: Final Output Graph

5. CONCLUSIONS

Finally, the power consumption can be reduced by using appliances that are automated based on environmental factors. Even if one unit of power is saved at consumer level then two units of power can be saved at the power station. Hence there is importance of smart systems to increase power consumption. The paper suggests few smart power saving systems which also increases the comfort level of individuals with minimum expenditure. We have also implemented a biometric door lock system which provides maximum security. The automation system implemented makes life easier, peaceful and saves the world power crisis. The components used to implement the module such as the controller, sensors, relays and transmitters are cheap and accurate and are readily available to install. The proposed system can be further implemented in large industrial automation, public places and security system.

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