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HOME AUTOMATION USING IMAGE PROCESSING AND SENSOR NETWORK

Nishanta Talukdar*, Keshav Kumar Singh*
& D. Jyothi Preshiya**
* Student, Department of ETCE, Sathyabama University, Tamilnadu
** Assistant Professor, Department of ETCE, Sathaybama University, Tamilnadu

Abstract:

Home automation is the recent trend in the field of embedded systems and plays a major role in designing various smart home hardware and software designs. Its very interesting to see how home automation concepts has made the life possible for humans. Here through our paper we are proposing a home automation system which runs on the gesture input given by the owner as well it runs on various embedded sensors which constitute our home automation system and drives the peripherals attached to the microcontroller board.

Key Words: Gesture Recognition, Wireless Sensor Network, Raspberry Pi & Arduino

1. Introduction:

Home Automation systems have developed a lot from the past. And with the passing time the home automation systems have made the life easier for humans with respect to controlling the various household electrical and mechanical appliances. Home automation is basically automating the control of our home so it works for us, adding convenience and making our life easier even while saving energy. It can be as basic as dimming light with a remote control or as complex as setting up of a network of appliances in your home such as a thermostat, security system, lighting and appliances) that can be programmed using a main controller or even with your cell phone from anywhere in the world! It is now possible, using wireless home automation devices with state-of-the-art Z-Wave technology, to control every aspect of your home environment without installing a single wire. The definition and capabilities of home automation have changed considerably over the years. Three decades ago, when home automation was rarely thought of by most people, consumers were promised "the home of the future." Home automation was known primarily to X10 enthusiasts and was installed by professionals in luxury homes. [1] Today's technology makes it install their own home control systems, and home automation was rarely thought of by most people, consumers were promised "the home of the future." Home automation was known primarily to X10 enthusiasts and was installed by professionals in luxury homes. Today's technology makes it simpler and more affordable for homeowners to purchase and install their own home control systems, and home automation has finally become a mainstream reality for the average consumer wanting to live in a "smart home".

The numerous benefits of today's home automation solutions include: safety and security, energy savings, money savings, convenience and control. It can also improve the daily life of seniors and the disabled by offering voice control and safety items. Beyond what has been stated in the field of demand-side management in smart grids, there exist numerous techniques in recent works, which have been applied for domestic energy management and task scheduling aims. Although these techniques have been mainly based on deterministic and/or meta-heuristic methods, they have failed to consider the users' convenience and com-fort levels as competitive objectives in their optimization problems. [1] To the best of our knowledge, none of the previous research works have considered a detailed optimization problem, which has taken into account the energy saving and. comfortable lifestyle as objectives of a realistic smart home

energy management system. Therefore in this paper we are suggesting to build a home automation system based on various gestures as well as wireless sensors which will prove to be an efficient method in controlling the various electrical appliances inside the room. Rest of the paper is organized as follows. Section [1] explains about the past developments in the field of home automation. Section [2] gives details about the preliminary authentication Part proposed in our system. Section [3] attributes about the Gesture Recognition part. Section [4] gives details about overall system design. Section [5] classifies about the arduino peripherals Section [6] gives the conclusion part. The main contributions of this paper could be summarized as follows.

- The first thing to be noted in this paper is that the home automation system proposed in this paper runs basically on the various gestures provided by the user as well as the various sensors implicated inside the smart home.
- Secondly coming to the working part the image processing used inside the smart home is done basically by the embedded board "Raspberry pi". The camera attached to the raspberry pi basically captures the image and then the image recognition and the subsequent action is taken by the raspberry pi.
- The next step into the system is controlling the electrical devices driven by gestures which are again controlled by the Raspberry pi.
- Finally the last step in the system is again controlling the peripherals driven by the wireless sensor which is controlled by the Arduino board.

2. Preliminary Authentication Section:

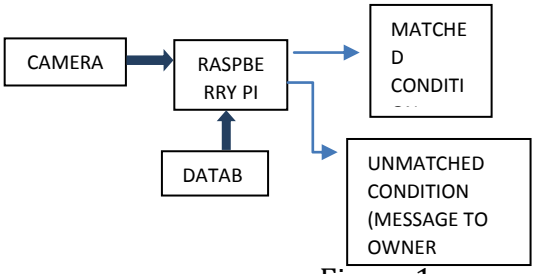

Figure 1

As we can see from the above block diagram at first a image of the person trying to enter the home is taken which is at the preliminary stage compared with the default image of the owner stored in the database. The image of the owner known as the person 1 and the image of the new person known as the person two are taken in six different moods to avoid any delicacy. Hence if the image of the new person's face matches with the face of the owner than a matched condition occurs and eventually the person gets entry into the smart home.

If the face of the new person doesn't match with the face of the owner than an unmatched condition occurs and eventually a message is sent through the GSM to the owner's mobile called as "UNAUTHORISED ENTRY". So as we can see this is the main authentication process used to confirm an entry into the 'smart home'. This authentication system provides the security system at the preliminary stage. As we can see from the above diagram for the gesture recognition section, firstly the user shows gesture into the camera. There is a provision of showing four gestures in the camera. The four gestures are being assigned four different combinations with the light and the motor.

In the subsequent process the gesture analyzed by camera is compared with the already stored gestures. If the gesture captured by the camera matches with any of the gesture stored in the database that is already designed than finally the action signal is

given to the microcontroller. The microcontroller or the raspberry pi controls all the peripherals attached to the raspberry pi. The main frame or the switch controls all the electrical devices or the peripherals attached to the raspberry pi based on the various gestures sampled by the raspberry pi. 2 relays are used to control the LED and the DC Motor.

3. Overall System Design:

A. System Description:

In this paper, since we are designing a home automation system based on gesture control and wireless sensor network it is very important that we get a very efficient result. The whole system basically revolves around the raspberry pi. But in the later part the arduino board also comes in to effect where it is used to control the various appliances or the various electrical devices used inside the room. The raspberry pi board uses the AVR microcontroller which comes along as a powerful microcontroller in the modern times with a clock speed of 1.7 Ghz. It has also 40 GPIO pins for I/O communication.

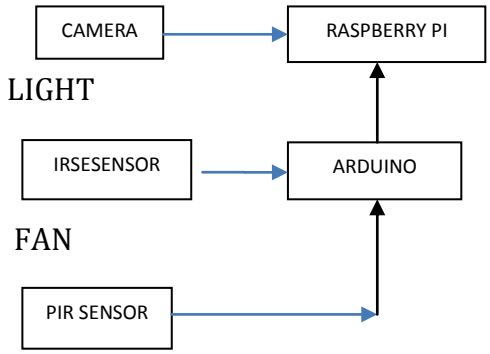

Figure 3

As we can see from the above block diagram the whole system involves the both the raspberry pi and the arduino microcontroller embedded board. The main raspberry pi Microcontroller board controls the gesture recognition part as well as the authentication part for the security part. The gesture recognition part is the most complex part involved in project. [2] The project involves the basic functioning of the home Automation system based on gesture as well as wireless sensor network. The gesture recognition part is the main part that we have involve in our project and it is the main improvement that we have include from the previous design of the home automation systems.

Figure 3

As shown in the above diagram we see the all types of hand gestures used in the project. The user shows the hand gesture in front of the camera and then the raspberry pi samples the image of the hand gesture shown by the user with the already stored

images of hand gestures stored in the database. If the image of the hand gesture shown by the user matches with any of the image of hand gestures stored in the database then the microcontroller takes the required action involved in controlling the peripherals attached to the microcontroller. The microcontroller takes the exact action according to the exact gesture involved.

FINGER 1	LIGHT OFF	FAN OFF
FINGER 2	LIGHT ON	FAN OFF
FINGER 3	LIGHT OFF	FAN ON
FINGER 4	LIGHT OFF	FAN OFF

Table 1

As we can see from the above given table there are for gestures that we have included in our project. The four gestures include showing of finger 1, 2, 3, 4. As shown in the table finger 1 indicates switching off of both the light and the fan. Similarly showing of finger 2 indicates to switching on of light and switching off of fan. In the same way finger 3 indicates the switching off of the light and switching one of the light. And finally showing of finger 4 indicates the switching off both the light and fan off. Hence in this way all the four fingers signal the switching on and off of the various peripherals attached to the microcontroller.

4. Arduino Periferals Section:

Figure 4

As we can see from the above diagram the arduino is mainly used to control all the peripherals implemented in the smart home. The smart home system is very helpful in making the life easy for the use and basically in our case it is the owner. Here in this part we have implemented both the IR sensor and one PIR sensor. These sensors sense the human presence and then they send a high signal to the respective sensors compiled inside the room. [2] Hence forth in this way we have implemented the arduino embedded board in controlling all the peripherals attached inside the room. The arduino proves to be very efficient in controlling all the sensors. The arduino board is an embedded board which has 20 GPIO pins which are used to control all the inputs and outputs attached to it. The arduino board is implicated with an atemega 328 microcontroller which is manufactured by the atmel company. Hence finally we have seen in the above project that how home automation systems are designed basically on gesture recognition and the wireless sensor network. The gesture recognition part is mainly controlled by the raspberry pi. It is shown in figure 6 that how the home automation systems were carried out in the past. It is shown that a communication transmitter was associated with the sensor giving inputs of high and low to the peripherals attached to the microcontroller board and a communication receiver was associated with the pheripherals attached so that it can receive the digital or analog inputs and work on the specified input. But the development that we have carried out in our project is that we have introduced a system on gesture recognition which makes the home automation system as proposed more efficient.

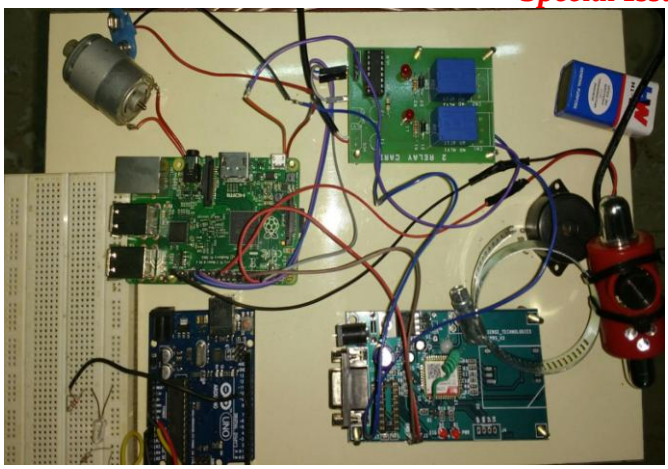

Figure5

But there are developments that can be implemented in the proposed system in this paper to make the system even more so as we can see from the above diagram we have taken two efficient. The development can be implemented as making Microcontroller boards – raspberry pi and the arduino board. The circuit involved in our proposed work less complex. The raspberry pi embedded board is given the major importance the other developments that can be made are like improving solely for the purpose of handling the authentication part as the working of the gesture recognition part to make the as the image processing part. The mouse and the keyboard is system more reliable, scalable and efficient. Well connected to the USB port of the raspberry pi board which is used to provide inputs in the case of authentication part and the gesture recognition part.

5. Conclusion:

The paper in details explains clearly about how the home automation proposed system is being carried out in the project. On the principle of gesture recognition. As mentioned in the management considering energy saving and a previous proposed works on home automation it was basically comfortable lifestyle'. Carried out with implementation of various sensor networks. In those cases the home automation system though was a discovery in the field of embedded systems but it failed due some or the other efficiency in case of home automation system designs. Hence home appliances control through static new improvements was needed in the field of home automation finger gestures. This came with the integration of gesture recognition in the systems related to home automation.

6. References:

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