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Iot Based End to End Solutions for Industrial Surveillance using Raspberry Pi

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Abstract- The proposed system introduces an industrial surveillance system providing a secure data flow with privacy & authenticity in the domain of Automation. This system makes use of Raspberry Pi to provide automation in a workplace environment, utilizing the benefits of IoT. It is used in an industrial scenario for authenticating and monitoring entry and exit of employees, automatic turning ON/OFF of lights and temperature control. All operations are controlled by Raspberry Pi which also acts as the server. Programming languages used are Python & C. Entry and exit of employees are authenticated using Finger Print Scanner. All the information of an employee along with finger print template is already enrolled in database. So every time, the input from fingerprint sensor is authenticated with templates in database to provide access and store time logs. Similarly inputs from temperature sensor and LDR are accessed and sent to server for uninterrupted monitoring and safety services. MQTT protocol is used as the communication protocol for transferring data to IOT server.

Keywords- IoT, Raspberry Pi, MQTT & DHCP

I. INTRODUCTION

A. Internet of Things (IoT)

In this era of Internet, IoT is a promising upcoming technology, strengthening by the minute. Data is acquired and analyzed which is then distributed as information. This fast growing field can revolutinalize any field whether it is residential, commercial or industrial. Industrial predictions had already gone around stating that 2020 will mark the beginning of more than 40 billion devices interconnected, which will be many a times greater than all connected mobile devices and internet hosts. Internet of things was developed as a result of different technologies, including wireless telecommunication, machine & deep learning, sensor technology and finally real time embedded systems. IoT was hence enabled as the result of contribution from many fields such as wireless sensor technologies, embedded systems as well as control systems and many other streams. The Internet of things (IoT) is defined as a platform used to connect various objects like personal computers, present day smart phones and Tablets to the internet, bringing a new mode of communication from things to people and things to things.

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The introduction of IoT has opened up a new path for research and development in the field of industrial automation, which in recent times is gaining vast popularity. The IoT facilitates an easier interface of objects which can be sensed and remotely controlled through all presently active network structures. This sheds more light on the process of realizing the physical world on to many new & advanced computer-based systems. This paves way to the creation of an excitingly efficient as well as accurate system which has the added benefits of better economy and less manual control. The Human life is made more stress free and greatly benefitted by these connected devices. In addition to this, different wireless technologies help in providing remote access to the industrial environment for sharing all necessary information.

B. Raspberry PI

Raspberry Pi was created by its founders with the motto of teaching students especially from schools the basic knowledge in the field of computer science. This device was built to act as a single computer of credit card size. The Board supports a number of input as well as output peripherals. In Wireless Sensor Networks (WSN), Raspberry Pi acts as a controller node as well as processing node. Raspberry pi was originally built using Broadcom BCM2835 system on chip(soc). Dimensions were 85.6 mm × 53.98 mm × 17 mm, weighing only just 45g and very economical. This Single computer device consists of a main controlling as well as processing part, the processor. Random Access Memory acts as program memory. It also fosters a graphics chip along with various connectors for device to device connectivity. Added benefits of this device are reduced cost as well as power consumption with improved efficiency. An alkaline battery is the power source of the device. Raspberry Pi acts as a server which functions in connection with a framework of devices acting as single purpose clients. Digital (SD) flash memory which supports either 32GB or 64 GB or more, helps it to acts as a Secondary memory. In this proposed system IoT and Raspberry Pi are used in combination for monitoring and controlling manpower of the organization along with automation of various devices associated with the process.

II. LITERATURE SURVEY

Sarthak Jain, Anant Vaibhav et al, in the paper" Raspberry Pi based Interactive Home Automation System through E-mail" has dealt with Home automation which controls & monitors various home appliances and its characteristics.

It has different uses that ranges from a normal LED control to more sophisticated systems which are controlled using microcontrollers. This method utilizes the received electronic mail .This mail is analyzed with the

help of proposed algorithm burned into the Raspberry Pi device.

The presented system was seen to have good efficiency and adaptability which met the requirements of the customer. This method was verified with the help of LEDs and the results justifying this have been presented. This project hence can be widened for more applications other than surveillance, power and fault monitoring, power control, security etc. A big disadvantage of this system is E-mail intimation is a report. Hence further processing is required to be done manually.

Narender M ,Vijayalakshmi M et al, in the paper "Raspberry Pi based Advanced Scheduled Home Automation System through E-mail", has put forward an innovative idea of including an interconnected web of various devices under domestic automation processes. When the residing individual is not at his residence, he might want to keep a few lights in ON condition. Also, as the resident has not entered his home for some time now, he might want to turn ON different home appliances before he makes his comeback. All these operations can be performed and controlled remotely by making use of present day web connectivity. This paper proposes a method to schedule domestic automation processes via Electronic mail with the help of Raspberry board. Disadvantage of this paper is that it emphasizes single way communication by sending an email to a single person.

Raguvaran k, Thiyagarajan M et al, in the paper "Raspberry PI Based Global Industrial Process Monitoring through Wireless Communication", proposed a technique to design a two layer SMD board using various sensing devices which compiles as well as communicates all the obtained data via different devices. This system makes use of Linux OS. PLCs are connected using distributed control system via different communication protocols such as RS232/485, USB and Ethernet. This sophisticated multilayer structure makes connectivity more expensive and complicated. The java simulators monitor as well as control the front end panel while Java servers are used for field control. The disadvantage in this paper is that it can be used only for that particular industry. Another thing is that it can only be used in a particular WIFI range.

III. PROPOSED SYSTEM

In this proposed system RASPBERRY PI and IOT are used in combination**.** Here IOT is used in an industrial scenario for authenticating and monitoring entry and exit of employees, automatic turning ON/OFF of lights and temperature control. Industrial automation is an integrated system consisting of various sensing devices as well as control units interconnected providing the consumer with remote control access to all the devices and their informative data. Consisting of various components such as raspberry pi board, light sensor, fingerprint sensor as well as temperature sensor which allows us to control the lighting system of our industry, entry and exit of employees and temperature control, this method is also very economic as well as efficient. All these operations are supervised by a remotely controlled server. It also allows a constant supervisory system to monitor different parameters using a smart phone or with a central server room.

A. System Block Diagram

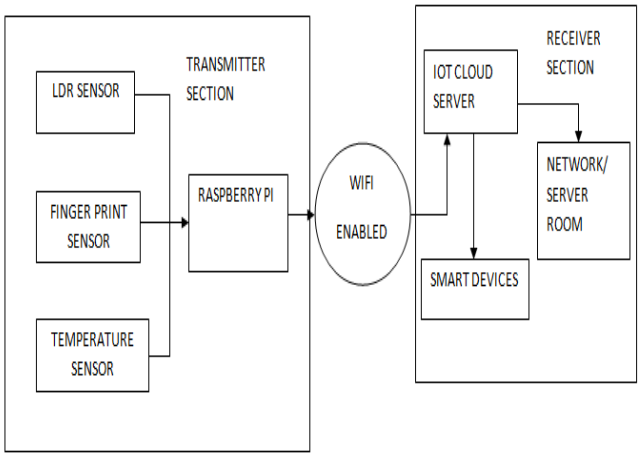

Fig. 1. Block diagram of Proposed System

1. Transmitter section

The transmitter section consists of components such as Raspberry Pi, Finger Print Scanner, PIR, LDR and Temperature Sensor. Here Raspberry Pi board serves to be the main control system.

- *Finger print sensor:* Finger Print Scanner is used to authenticate entry and exit of employees. All the information of an employee along with finger print template is already enrolled in the database. Every time while logging-in employees will keep their finger on the sensor and in the background a process will be running to make sure if the fingerprint template is present. This will be done by comparing with the set of templates enrolled. If the appropriate match exists, then it is displayed as “Finger Print enrolled successfully”, else it is displayed as “Finger Print not matched”. After enrolling the finger the image will be downloaded and saved in temp files.
- *Temperature sensor:* The room temperature is monitored using temperature sensor. If the temperature value exceeds the fixed threshold level (user defined temperature, default value is 34 degree Celsius) the AC will be automatically turned ON.
- *LDR sensor:* When an individual makes an entry into the room, the PIR sensor detects this presence and LDR turns ON the lights. The light will be ON even when a single person does not exit the room.
- *Raspberry PI:* All these outputs are stored in the controller device i.e inside raspberry pi file system as txt files and output from fingerprint sensor is stored in .bmp format. Raspbian OS is connected to internet using DHCP protocol. Hence our controlling device access internet using Wi-Fi, the data from all sensors are published to IoT cloud server by using MQTT

- protocol. Raspberry Pi at different location acts as MQTT client and publishes data to MQTT broker (IoT Cloud manager).

2. Receiver section

In receiver section the information in the raspberry pi is shared with cloud server through

MQTT client as explained earlier in transmitter section. The data in the server can be directly monitored by logging in from server/control room. It can also be monitored from smart devices by subscribing for the data to MQTT broker. But in this paper the data files are shared with an open source one drive cloud server by creating a login in Microsoft one drive.

Procedure for sharing the data files are by storing the necessary data files inside a dedicated folder inside Raspbian file system. Then the dedicated folder will be shared by initially syncing with cloud server. If syncing is successful, data files from local storage will be shared with the cloud server, which can be verified by logging in the server with authentication. Once after receiving the information, from the Integrated control room, necessary actions are taken, i.e. based on the login information from fingerprint sensor, the number the employees inside the work station will be identified and this information is cross checked from the values obtained from the LDR sensor, as LDR sensor module gives out 0s and 1s. If a 0 is detected then the login details from finger print sensor will be reviewed.

IV. PROPOSED METHODOLOGY

A. Implementation Of Fingerprint Scanner

In this Proposed System a fingerprint scanner is used. This scanner is a 4 pin connector consisting of a pin to connect to a voltage of range 3.3 to 6V, a pin for ground, a pin for transmission as well as reception to various devices. When the light is on (off) then connect finger print scanner to the Raspberry pi using the GPIO pins. By default Raspberry pi serial port is configured to be used for console input/output and adapter to pins 4 of Raspberry pi.

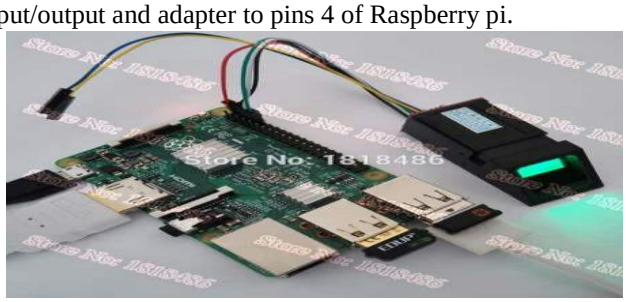

Fig. 2. Finger Print Scanner

1. Enroll

Enrolling the finger print is the first step for storing the data in database. Place a finger on the scanner for enrollment when the red light is ON. The sensor reads image to characteristics and stores it in charbuffer1 and checks if finger is already enrolled. Now remove the finger. Again the sensor is waiting for the same finger, so place the finger until the sensor reads. It converts the read images to characteristics and stores it in charbuffer2.If the finger template already exist it displays “Finger Print enrolled successfully”, else it is displayed as “Finger Print not matched”

2. Search

Here the sensor tries to search the fingerprint and calculate hashes by loading the found template to charbuffer1 and downloads the characteristics of template loaded in charbuffer1.

3. Download

After enrolling the finger, the sensor tries to read image and download it. Downloading an image will take a while. The downloaded image is saved in temp files as "fingerprint.bmp"

B. Implementation Of Temperature Sensor

In the proposed system DS18B20 digital thermo sensor is used. This sensor displays temperature (in Celsius) as 9-12 bits. It also has an alarm provision that has lower as well as higher triggering spots. Single wire bus is used for sensor communication. This is connected with raspberry pi through GPIO pins.

C. Implementation Of LDR Sensor

In the Proposed system an LDR is used. The working principle of this sensor is that as incident light increases, the resistance of the sensor decreases. Output signal acts as trigger for the Raspberry Pi board. The LDR module is connected to the raspberry pi using dupont wires. Connections are given in **Fig. 3**.

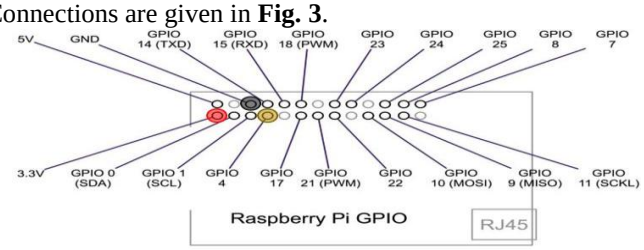

Fig. 3. Light Sensor Module Connection with GPIO

V. RESULTS AND DISCUSSION

A. Output from LDR Sensor

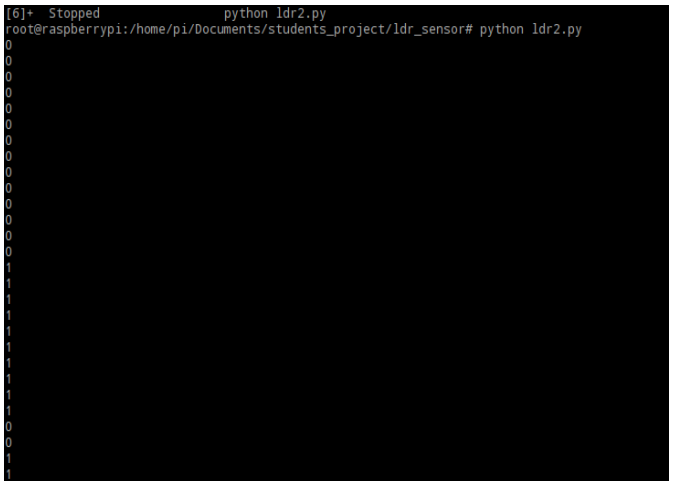

Fig. 4. Final Output of LDR Sensor

Fig.4 Shows the output of LDR Sensor. When an individual makes an entry, PIR Sensor detects this presence and LDR turns on the light.

The light will be ON even a single person does not exit the room. From the Figure,

0(TRUE) = INDICATES PRESENCE OF LIGHT

1(FALSE) = INDICATES ABSENCE OF LIGHT

B. Output from Temperature Sensor

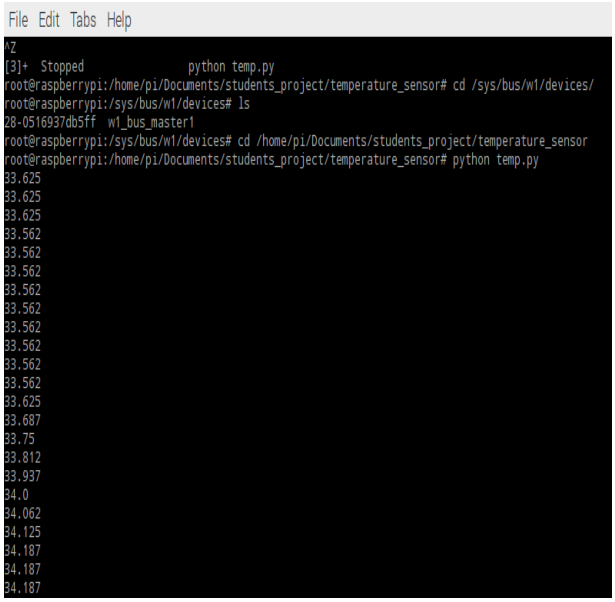

Fig. 5. Final Output of Temperature Sensor

Fig.5 Shows the output of Temperature Sensor .If the Temperature value exceeds above the fixed threshold level(user defined temperature, default value is 34 degree celcius) the AC automatically turns ON.

C. Output from Fingerprint Scanner

Fig. 6. Reduced Block

Here we have the output of Finger Print sensor. The employee should first enroll the finger. If it already exists, it displays the finger print enrolled successfully or if not exist the finger print does not match. After enrolling the finger the image will be downloaded and saved in Temp files.

D. IoT Server Output

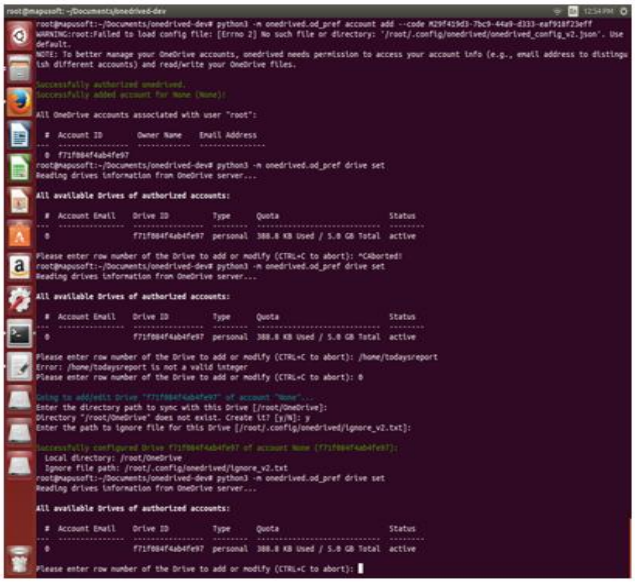

Fig. 7. Microsoft One drive Server Output 1

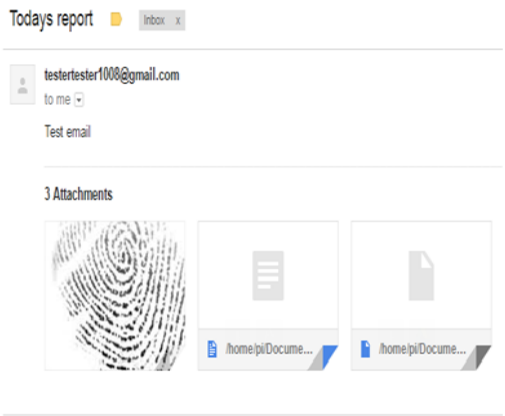

Fig. 8. Microsoft One drive Server Output 2

Figure 7 & 8 illustrates the data from sensors available to Microsoft one drive server.

E. Automated Mail Output

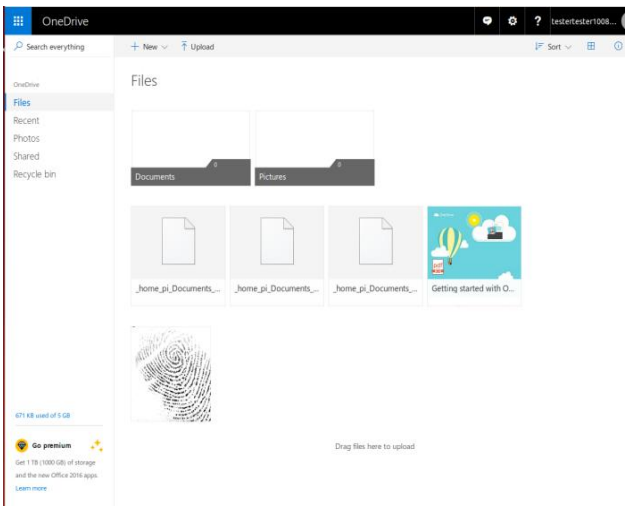

Fig. 9. Automated Mail Output

Fig.9 Shows the Screen Shot of Automatic mail to the Administrator.

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That all the information of the Sensors are sent by mail through Wi-Fi. So the information can easily be viewed by the admin.

VI. CONCLUSION AND FUTURE SCOPE

A. Conclusion

This paper presents an end to end solution for industrial surveillance via Internet of Things for monitoring exit and entry of employees, automatic turning on/off light and temperature control without human intervention. This goal is obtained with the help of a Raspberry Pi B board and various sensors connected to it. Programming languages used are Python as well as C. Raspberry pi was connected to internet by Wi-Fi using DHCP protocol. PuTTy which is a free as well as open source SSH software made in use for remote connectivity of the computers via internet. All the sensors outputs are stored in Raspberry Pi file system inside a dedicated folder which is further attached to email and also shared to Microsoft One drive cloud server. Eclipse is used as development environment with GNU ARM eclipse cross compiler for compiling C codes. The proposed system is economical, adaptive and conserves energy. The system has the capability to solely function as well as to be remotely controlled with the necessary information send by EMAIL to the IOT server room and smart devices through cloud storage.

B. Future Scope

Internet of things paves a new and innovative way to make life easier. Its applications are not only limited to the industrial domain but other fields such as data security, health as well as energy monitoring and many others. In the near future the concept of internet of things can be seen in applications like machine-driven fireplace exit systems, improvement of security problems in extremely restricted areas, environmental monitoring in weather stations and in industries where human invasion is impossible or Dangerous along with the usage of compact and power device i.e Raspberry Pi.

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