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HOME SECURITY SYSTEM BASED ON IOT USING RASPBERRY PI-3

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ABSTRACT

IoT coverage is very wide and includes variety of objects like smart phones, tablets, digital cameras and sensors. Once all these devices are connected to each other, they enable more and more smart processes and services that support our basic needs, environment and health. The main objective of present work is to design a smart home using various sensors which can be controlled and monitored by the ESP8266 Controller and Raspberry PI-3 via the Internet of Things (IoT). The home automation system is also implemented around the same ESP8266 controller, which includes a smart doorbell, the smart locker security system has the control by Raspberry PI – 3. Today we are living in 21st century. It is necessary to control the home from desire location. Home automation is the control of any electrical and electronic device in our home and office, whether we are there or away. Home automation is an important milestone in achieving smart grid and is ever exciting field that has exploded over the past few years. Introducing the raspberry PI to the world of home automation provides numerous customizations to turn a regular home into a smart home. Raspberry PI – 3 provides a low cost platform for interconnecting electrical/electronic devices and various sensors in a home via the internet network. It comprises of a two way communication where electricity and information is exchanged by the consumer and utility to maximize efficiency.

Keywords :-Smart locker, Internet of things (IoT), ESP8266 controller, Respberry PI-3

I.INTRODUCTION

The IoT is the network of physical objects or things embedded with electronics, software, sensors and connectivity to enable it to achieve greater value and service by exchanging data with the manufacturer, operator and other connected device. Each thing is uniquely identifiable through its embedded computing system but it is able to interoperate within the existing internet infrastructure. IoT communicates information to people and systems such as state and health of equipment and data from sensors that can monitor a person's vital signs.

The scope of the work is to develop a monitoring system by using Raspberry Pi-3 which acts as an interface between user and the devices. Live picture can be viewed by an LCD screen through USB camera. The Pi is a low cost microcomputer that is able to run on Linux and can give endless extension possibilities. The work require a very low energy consumption, whereby the Raspberry Pi-3 operates with 5V power.

Most of the home security system available in the market consist of a control panel that is installed somewhere in the house.The down-side of the system is that the home users are not be able to access and customized the control panel when they are away from their home.

The motivation to build up this system is due to the high number of home invasion and burglary reported every year.According to The star News,during the year 2014,the number of residential break-ins in Malaysia was 11.7% of the national crime index which is definitely a worrying number for the small nation.[6]

II.PROPOSED SYSTEM

The block consists of USB camera, Raspberry Pi Mod-b3, PIR sensor, ESP8266 controller, Relay control, Arduino UNO, GSM Module, and LCD During the night time, PIR sensor detects any motion in front of home, it sends signal to Arduino and Raspberry pi the USB camera will capture the video detection of the person and it is viewed in the LCD screen inside the home. In order to activate the smart locker system, first we need to enter the password through keypad. If the password matches with the set password system gets activated. If the password mismatches then an alert message will send to the owner via the GSM module and the owner will give a shock to the intruder via the modular app. This system is very useful and it provides more security to the home.

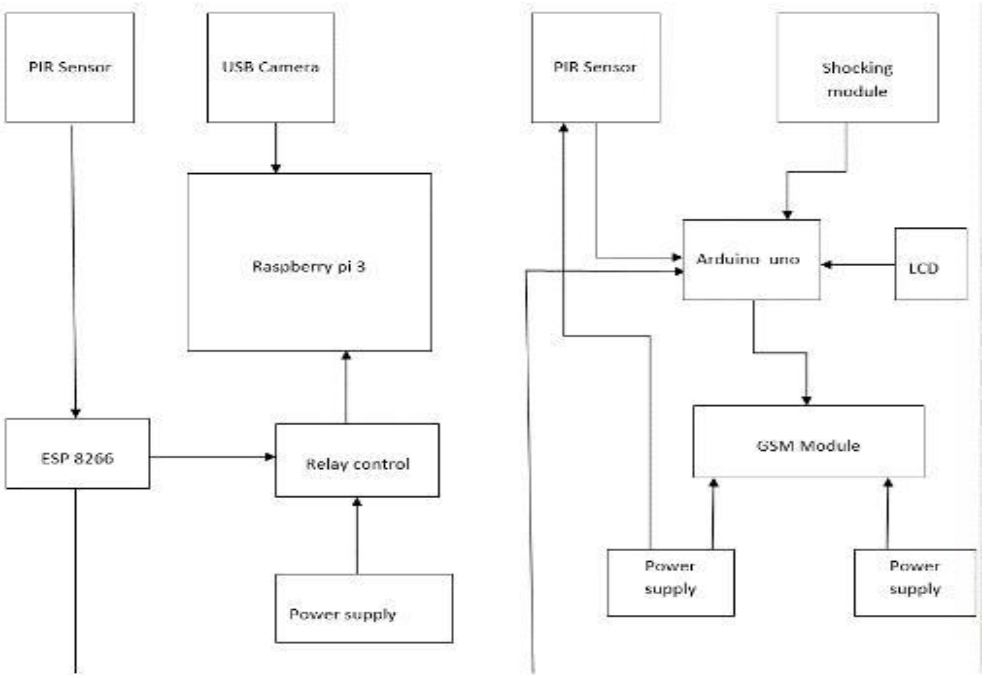

Fig.1.block diagram

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III. HARDWARE DESCRIPTION

3.1 PIR SENSOR:-

An individual PIR sensor detects changes in the amount of infrared radiation impinging upon it, which varies depending on the temperature and surface characteristics of the objects in front of the sensor.

Fig.3.1.PIR sensor

When an object, such as a human, passes in front of the background, such as a wall, the temperature at that point in the sensor's field of view will rise from room temperature to body temperature, and then back again. The sensor converts the resulting change in the incoming infrared radiation into a change in the output voltage, and this triggers the detection. Objects of similar temperature but different surface characteristics may also have a different infrared emission pattern, and thus moving them with respect to the background may trigger the detector as well.PIRs come in many configurations for a wide variety of applications. The most common models have numerous Fresnel lenses or mirror segments, an effective range of about ten meters (thirty feet), and a field of view less than 180 degrees. Models with wider fields of view, including 360 degrees, are available-typically designed to mount on a ceiling. Some layer PIRs are made with single segment mirrors and can sense changes in infrared energy over one hundred feet away from the PIR. There are also PIRs designed with reversible orientation mirrors which allow either broad coverage (110 wide) or very narrow ―curtain‖ coverage, or with individually selectable segments to ―shape‖ the coverage.

3.2 USB camera :-

USB camera are imaging cameras that use USB 2.0 or USB 3.0 technology to transfer image data. USB cameras are designed to easily interface with dedicated computer systems by using the same USB technology that is found on most computers.

FIG 3.2 USB camera module

A webcam is a video camera that feeds or streams its image in real time to or through a computer to computer network. When ―captured‖ by the computer, the video stream may be saved, viewed or sent on to other networks via systems such as the internet, and email as an attachment. When sent to a remote location, the video stream may be saved, viewed or on sent there. Unlike an IP camera (which connects using Ethernet or Wi-Fi), a webcam is generally connected by a USB cable, or similar cable, or built into computer hardware, such as laptops.

WORKING OF WEBCAM :-

A webcam is a compact digital camera that can hook up to the computer to broadcast video images in real time. Just like a digital camera, it captures light through a small lens at the front using a tiny grid of microscopic light-detectors built into an image-sensing microchip (either a charge-coupled device (CCD)or, more likely these days, CMOS IMAGE SENSOR). Unlike a digital camera, a webcam has no built-in memory chip or flash memory card: it doesn't need to ―remember‖ pictures because it's designed to capture andtransmit them immediately to a computer. That's why webcams have USB cables coming out of the back. The USB cable supplies power to the webcam from the computer and takes the digital information captured by the webcam's image sensor back to the computer-fromwhere it travels on to the Internet. The objects which are needed to be counted are capture using USB camera.

CHARACTERISTICS :-

Webcams are known for their low manufacturing cost and their high flexibility, making them the lowest-cost form of video telephony. Despite the low cost, the resolution offered at present (2015) is rather impressive, with low-end webcams offering resolutions of 320*240, medium webcams offering 640*480 resolution, and high-end webcams offering 1280*720 (aka 720p) or even 1920*1080 (aka 1080p) resolution. They have also become a source of security and privacy issues, as some built-in webcams can be remotely activated by spyware.

3.3 GSM Module :-

Global System for Mobile Communications, is a standard developed by the European Telecommunications Standards Institute (ETSI) to describe the protocols for second-generation (2G) digital cellular networks used by mobile phones, first deployed in Finland in July 1991.2G networks developed as a replacement for first generation (1G) analog cellular networks, and the GSM standard originally described a digital, circuit-switched network optimized for full duplex voice telephony. This expanded over time to include data communications, first by circuit-switched transport, then by packet data transport via GPRS and EDGE .Subsequently, the 3GPP developed third-generation (3G) UMTS standards followed by fourth-generation (4G) LTE Advanced standards, which do not form part of the ETSI GSM standard. GSM is a cellular network, which means that cell phones connect to it by searching forG cells in the immediate vicinity. There are five different cell sizes in a GSM network—macro, micro, and umbrella cells. The coverage area of each cell varies according to the implementation environment. Macro cells can be regarded as cells where the base station antenna is installed on a mast or a building above average rooftop level. Micro cells are cells whose antenna height is under average rooftop level; they are typically used in urban areas. Pico cells are small cells whose coverage diameter is a few dozen meters; they are mainly used indoors. Femto cells are cells designed for use in residential or small business environments and connect to the service provider's network via a broadband internet connection. Umbrella cells are used to cover shadowed regions of smaller cells and fill in gaps in coverage between those cells. Cell horizontal radius varies depending on antenna height, antenna gain, and propagation conditions from a couple of hundred meters to several tens of kilometers. The longest distance the GSM specification supports in practical use is 35 kilometers (22 mi). There are also several implementations of the concept of an extended cell, where the cell radius could be double or even more, depending on the antenna system, the type of terrain, and the timing advance .Indoor coverage is also supported by GSM and may be achieved by using an indoor base station, or an indoor repeater with distributed indoor antennas fed through power splitters, to deliver the radio signals from an antenna outdoors to the separate indoor distributed antenna system.[5]

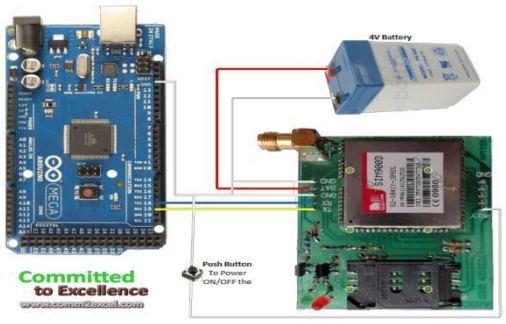

Fig.3.3Gsm Module

3.4 SD CARD WRITER :-

Secure Digital (SD) is a non-volatile memory card format developed by the SD Card Association (SDA) for use in portable devices. There are many combinations of form factors and device families, although as of 2016, the

prevailing formats are full or micro size SDHC and SDXC cards. Its digital includes four card families available in three different form factors. The four families are the original standard-capacity (SDSC), the high-capacity (SDHC), the extended-capacity (SDXC), and the SDIO, which combines input/output functions with the data storage. The three form factors are the original size, the mini size, and the micro size.

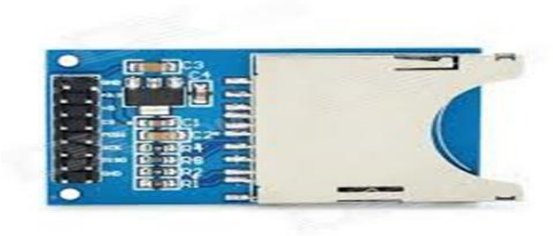

Fig.3.4.SD card writer

3.5 ARDUINO :-

Arduino is a software company, project, and user community that designs and manufacturing computers open-source hardware, open-source software, and microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices. The Arduino Uno is a microcontroller board based on the objects that can sense and control physical devices.

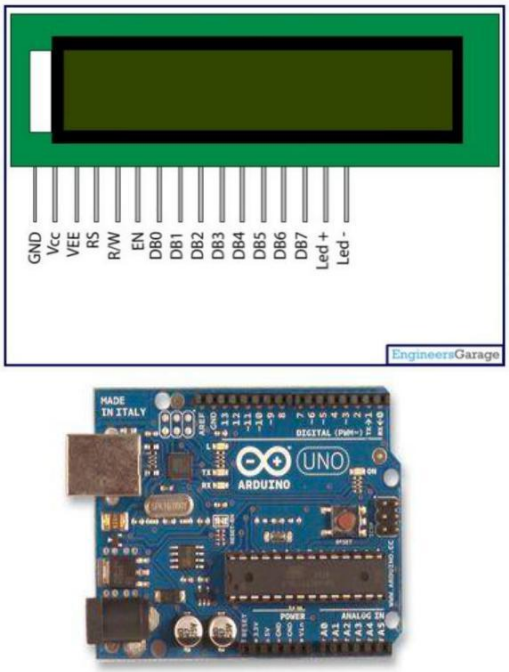

Fig.3.5Arduino

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures.3.6 [1] LCDMODULE

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over sevensegments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special and even customcharacters, animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. LCD display is used to display the number of objects counted using Raspberry Pi processor

Fig.3.6 LCD module

Table3.6 Specification of LCD module

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select

5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

3.7 ESP8266 Controller:

The ESP8266 is a low cost Wi-Fi chip with full TCP/IP stack and MCU (Micro ControllerUnit) capability produced by Shanghai-based Chinesemanufacturer, Espress if Systems. The chip first came to the attention of western makers in August 2014 withESP01 module, made by a third-party manufacturer, AI-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at the time there was almost no English-language documentation on the chip and the commands it accepted. The very low price and the fact that there were very few external components on the module which suggests that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation. The ESP8285 is an ESP8266 with 1 MB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi.SDKsIn late October 2014, Espressif released a software developmentkit (SDK) that allowed the chip to be programmed,removing the need for a separate microcontroller. Since then, there have been many official SDK releases from Espressif; Espressif maintains two versions of the SDK — one that is based on RTOS and the other based on callbacks.Other open source SDKs includeArduino: a C++ based firmware. This core enables the ESP8266 CPU and its Wi-Fi components to be programmed like any other Arduino device. The ESP8266 Arduino Core is available through GitHub they are collectively referred to as "ESP-xx modules" and to form a workable development system require additional components, especially a serial TTL-to-USB adapter (sometimes called a USB-to-UART bridge) and an external 3.3 Volt power supply. Novice ESP-8266 developers are encouraged to consider larger ESP8266 Wi-Fi development boards like the NodeMCU which includes the USB-to-UART bridge and a Micro-USB connector coupled with a 3.3 Volt power regulator already built into the board. When project development is complete, you may not need these components and can consider using these cheaper ESP-xx modules as a lower power, smaller footprint option for your production runs. The popularity of many of these "other boards" over the earlier ESP-xx modules is the inclusion of an on-board USB-to-UART bridge (like the Silicon Labs' CP2102 or the WHC CH340G) and a Micro-USB connector coupled with a 3.3 Volt regulator to provide both power to the board and connectivity to the host (software development) computer commonly referred to as the console. With earlier ESP-xx modules, these two items (the USB-to-Serial adaptor and a 3.3 Volt regulator) had to be purchased separately and be wired into the ESP-xx circuit. Modern ESP8266 boards like the NodeMCU boards are a lot less painful and offer more GPIO pins to play with. Most of these "other boards" are based on the ESP-12E module, but new modules are being introduced seemingly every few months.

- It has GPIO, I2C, ADC, SPI, PWM and some more
- It is wireless SoC
- It's running at 80MHz
- 64KBytes of instruction RAM
- 96KBytes of data RAM
- 64KBytes boot ROM
- It has a Winbond W25Q40BVNIG SPI flash

- It's a RISC architecture
- The core is a 106micro Diamond Standard core (LX3) made by Tensilica
- The ESP8266 chip is made byEspressif
- Modules bearing this chip are made by variousmanufacturer

3.8 RASPBERRY PI -3 MODEL B:-

Raspberry Pi 3 is an upgrade to a next generation main processor and improved connectivity with Bluetooth Low Energy (BLE) and BCM43143 Wi-Fi on board. Additionally, the Raspberry Pi 3 has improved power management, with an upgraded switched power source up to 2.5 Amps, to support more powerful external USB devices.The Raspberry Pi 3's four built-in USB ports provide enough connectivity for a mouse, keyboard, or anything else that one feel the RPi needs and can add even more still use a USB hub. Keep in mind, it is recommended that use a powered hub so as not to overtax the on-board voltage regulator. Powering the Raspberry Pi 3 is easy; just plug any USB power supply into the micro- USB port. There's no power button so the Pi will begin to boot as soon as power is applied, to turn it off, simply shut down the Pi 3 and then remove power. The four built-in USB ports can even output up to 1.2A enables to connect more power hungry USB devices (This does require a 2Amp micro USB Power Supply).On top of all that, the low-level peripherals on the Pi make it great for hardware hacking. The 0.1" spaced 40-pin GPIO header on the Pi gives access to 27 GPIO, UART, I^2C, SPI as well as 3.3 and 5V sources. Each pin on the GPIO header is identical to its predecessor the Model B+.There are two giant upgrades in the Pi 3. The first is a next generation Quad Core Broadcom BCM2837 64-bit ARMv8 processor, making the processor speed increase from 900 MHz on the Pi 2 to up to 1.2GHz on the Pi 3[3]

Fig 3.8 Raspberry pi 3 model B

3.8.1 RASPBERRY PI3 MODEL B SPECIFICATION

Table 3.8.1Raspberry pi 3 model b specification

Board	Raspberry Pi 3 Model B
Processor	Broadcom BCM2837
CPU Core	Quad core ARM Cortex-A53,64Bit
Clock Speed	1.2GHz (Roughly 50% faster than Pi2)
RAM	1 GB
GPU	400 MHzVideoCore IV®
Network Connectivity	1 x 10 / 100 Ethernet (RJ45 Port)
Wireless Connectivity	802.11n wireless LAN (Wi-Fi) and Bluetooth 4.1
USB Ports	4 x USB 2.0
GPIOs	2 x 20 Pin Header

Camera Interface	15-pin MIPI
Display Interface	DSI 15 Pin / HDMI Out /Composite RCA
Power Supply (Current Capacity)	2.5 A

3.8.2 RASPBERRY PI 3-PIN DIAGRAM

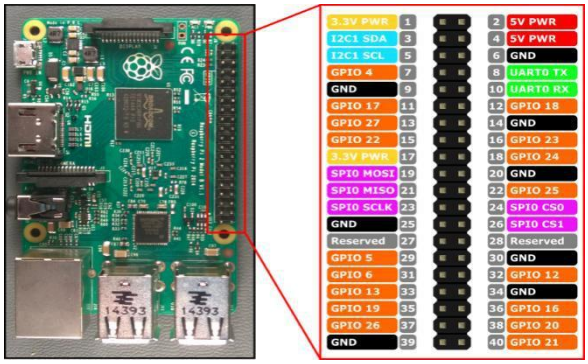

Fig 3.8.2 Raspberry pi 3-pin diagram

PIN DESCRIPTION:-

GPIO are the standard pins that simply be used to turn devices on and off.I2C (Inter-Integrated Circuit) pins allow connecting and talking to hardware modules that support this protocol (I2C Protocol). This will typically take up 2 pins.SPI (Serial Peripheral Interface Bus) pins can be used to connect and talk to SPI devices. UART (Universal Asynchronous Receiver/Transmitter) are the serial pins used to communicate with other devices.DNC stands for do not connect.The power pins pull power directly from the Raspberry Pi.[4] GND are the pins used to ground the devices.

IV. RESULT AND CONCLUSION

This project covers most important feature, in which it could provide the complete smart home environment. Our project mainly focuses on smart locker and security systems which are employed using Raspberry Pi module. The alarm system and the smart door bell system adds an advantage to our system. By building a system in such environment, it could play a lead role in real time scenario today. This includes the following process:

1. Fabrication of mechanical setup
2. Electronic circuitry wiring.
3. Programming the microcontroller
4. Testing and debugging.
5. Fusing hardware and software.[7]

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