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Development of Smart Emergency Detection System for Hospital

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Abstract: *The system deals with basic security and helps to detect and avoid accidents at the health care center by alerting about the presence of smoke particles, harmful gases, changes in temperature, and noise levels while an emergency. It works on solar power so it is eco-friendly. It contains lots of scope in the future to enhance and encourage the use of non-renewable energy*

Keywords: Arduino Uno, IoT Sensors, Relay, Wireless communication, PV solar module.

I. INTRODUCTION

The aim of this project is to avoid accidents in the health care center. The system deals with basic security and helps to detect and avoid accidents at the healthcare center by giving an alert about accidents. Generally, in this project, using sensor devices to detect smoke particles, harmful gases, and high temperature and noise levels for avoiding further casualties. The Arduino acts as the base regulator of the system. The whole system is powered through PV solar module so that a hamstrung force of electricity cannot be a problem in pastoral areas and hospitals. With the help of this system, a solution for the accidents at the health-care center and public domestic sector industry. This project is to design and develop a system that gives real-time alerts at the time incidents. To detect the presence of smoke particles and give an alert about the indication of fire. To measure the temperature levels and give a real-time alert about high-temperature levels in the environment. To detect noise/sound levels and give an alert about high noise levels. The Whole System gets power from Solar PV Module. The Energy generated by PV Module is stored in the energy storage device. The energy is distributed through a charge controller to the energy storage device and module.

II. LITERATURE REVIEW

To propose a solution for the accidents at the health-care center and public domestic sector industry. This project is to design and develop a system that gives real-time alerts at the time of incidents. To detect the presence of smoke particles and give an alert about the indication of fire. To measure the temperature levels and give the real-time alert about high-temperature levels in the environment. To detect noise/sound levels and give an alert about high noise levels. The Whole System gets power by Solar PV Module. The Energy generated by PV Module is stored in the energy storage device. The energy is distributed through a charge controller to the energy storage device and module.

III. HARDWARE SETUP

The data read from the device is passed to the microcontroller after that microcontroller processes the data and then it is passed to the transmitter. In fig 1. the transmitter will transmit the data through a wireless transmission system. After that, data is received by the receiver system then it will be procced through a micro-controller to give alerts about emergency incidents.

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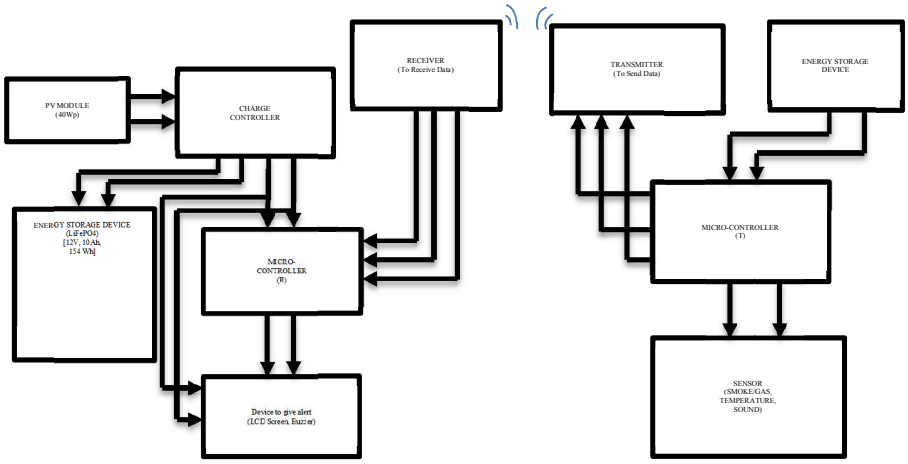

Fig 1. Block Diagram of System

On the side, the smoke particles detected by a device if the value of smoke in ppm crosses the threshold value will give an alert in the form of sound and display on the LCD screen. The system is powered through solar module so that an inefficient supply of power cannot be a problem in rural areas, healthcare and hospitals.

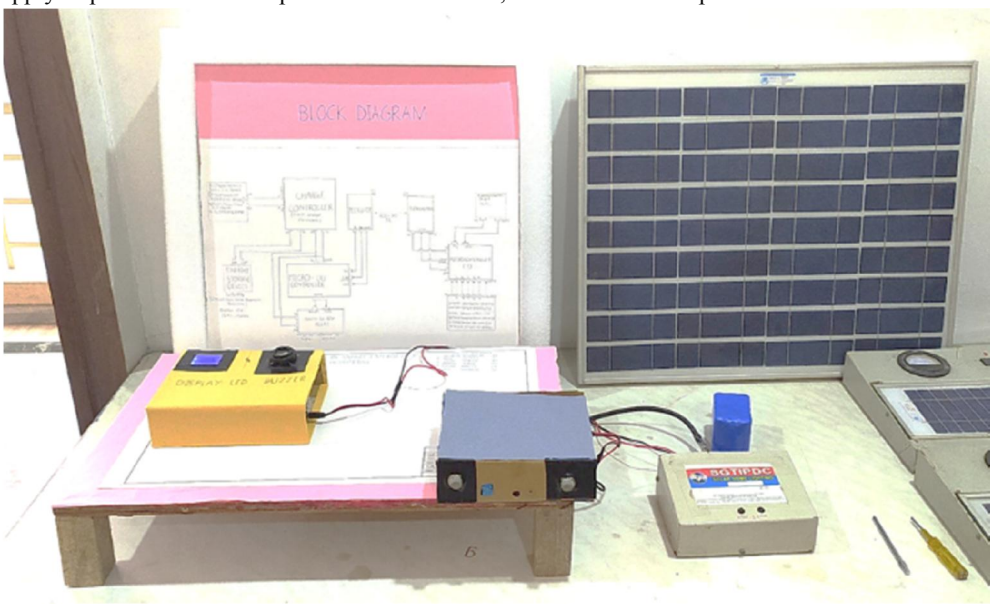

Fig 2. Hardware Setup of System

IV. WIRELESS COMMUNICATION SYSTEM

In radio communication, a transceiver is an electronic device that's a combination of a radio transmitter and a receiver. It can both transmit and admit signals using an antenna, for dispatches purposes. These two affiliated functions are frequently combined in a single device to reduce manufacturing costs. The term is also used for other bias which can both transmit and admit through a communication channel.

In fig 3. Experimental setup of the system transmitting side is observed.

The transmitting system is consisted of-

- Energy Storage Device
- Microcontroller
- Transceiver Module
- Smart Sensing Devices

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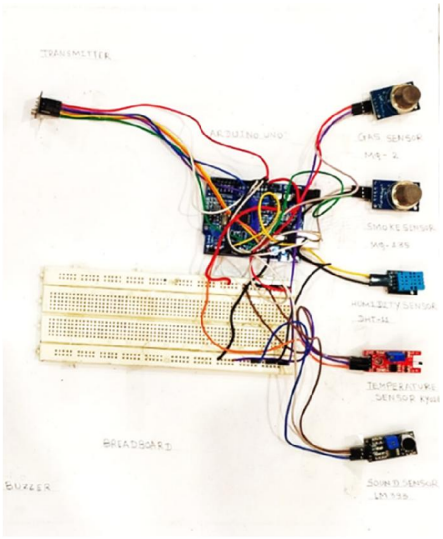

Fig 3. Experimental setup of the system transmitting side

In fig 4. Experimental setup of system receiving side is observed.

The Receiving system is consisted of-

- PV Solar Module
- Charge Controller
- Energy Storage Device
- Microcontroller
- Transceiver Module
- Nokia LCD
- Relay
- Buzzer

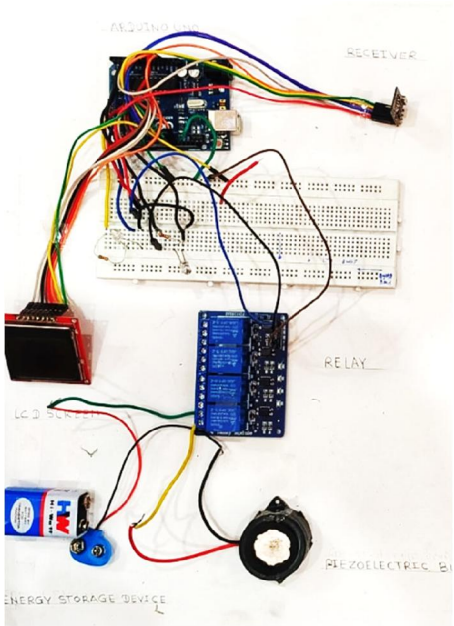

Fig 4. Experimental Setup of System Receiving Side

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PV Solar Module

A PV module is also known as a Photo-Voltaic module. A photovoltaic module is used as an energy power system, its function is to give doable energy and solar power through the use of the photovoltaics feature.

Fig 4. PV Module

In fig 4. PV modules help absorb energy from the sun's shafts and induce it as electrical power.

Specification of PV Module

STC (Standard Test Condition) is an assiduity-wide standard to indicate the performance of photovoltaic cell and specifies a cell temperature of 25 °C and irradiance of 1000 W/ m ² with an air mass of1.5 (AM1. 5) diapason.

In table 1. specification of PV module is given. Nominal electrical output at 25° Celsius and STC-

Quantity	Data
Pmax (Pm)	40.14 W
Voc	18 V
Isc	1.80 A
Vmax	22 V
Imax	2.23 A
Efficiency	12-14%

Table 1: Specification of PV Module

Calculation for PV Module:

Vm = 22volt; Voc = 18volt;
Im = 2.23amp; Isc = 1.80volt;
Rin = 1000 W/m2

Fill Factor = Vm * Im / Voc * Isc
FF = 22 * 2.2 / 18 * 1.8 = 0.74 * 100
FF = 60%

Efficiency % =
Voc * Isc * FF / Rin * Area of Panel
η % = 18 * 1.8 * 0.64 / 1000 * 0.225 *100
η% =14.19%

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Linear Charge Controller:

A linear charge controller is a device that just senses the voltage from the solar panels and gives it to the battery. The voltage obtained from the panel is given to the direct current load. In a linear charge controller, the PV solar module receives irradiation from the sun and converts this solar radiation into electrical energy through the 'Photo-Voltaic Effect'.

Fig 5. Solar Linear Charge Controller

The Major debit of this direct regulator is that it'll not do any conversion operations due to this there will are losses around and the effectiveness drops, also battery life gets reduced, so to minimize the losses from solar panel to the battery, modifying the being system by uniting with MPPT charge regulator which minimizes the losses and increases the effectiveness of the battery 95%.

Energy Storage Device

The Energy storehouse device enables energy from renewable coffers like solar and wind to be stored and released when the client is in need. It's possible to store the energy in the form of the electrochemical present in that which will convert chemical energy into electrical energy.

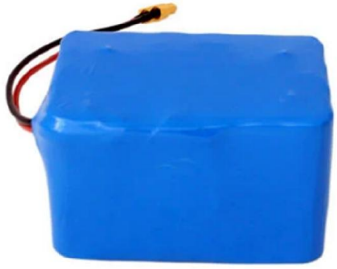

Fig 6. 12V 10Ah LiFePO4 Lithium Iron Phosphate Energy Storage Device

Voltage	12V
Amp Hours	10Ah
Energy	120 Wh
Resistance	≤90 mΩ; 50% SOC
Efficiency	99%
Self-Discharge	<3% per month
Cell Type	Cylindrical
Chemistry	$LiFePO_4$

Table 2. Specification of Energy Storage Device

Microcontroller

A Microcontroller may be a small and low-cost microcomputer, which is intended to perform the particular tasks of bedded systems like displaying fryer information, entering remote signals, etc. Arduino Uno is a microcontroller board grounded on the ATmega328P. The final microcontroller consists of the processor, the memory (RAM, ROM, EPROM), Periodical anchorages, peripherals (timekeepers, counters), etc.

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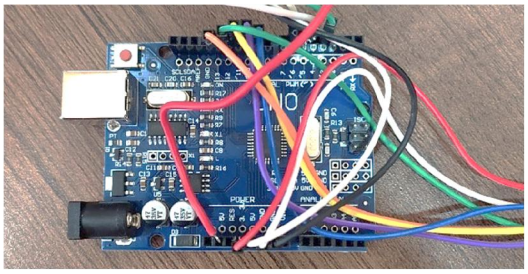

Fig 7. Microcontroller Arduino Uno Revision 3

Microcontroller has 14 digital input/ affair legs (of which 6 will be used as PWM labors), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, an influence jack, an ICSP title, and a push button. It contains everything demanded to support the microcontroller; simply connect it to a computer with a USB string or power it with an AC-to-DC appendage or battery to induce started.

Microcontroller	ATmega328P
Operating Voltage	5 Volt
Input Voltage (recommended)	7-12 Volt
Input Voltage (limit)	6-20 Volt
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mAmp
DC Current for 3.3V Pin	50 mAmp
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz

Table 3. Technical Specifications of Microcontroller Arduino Uno Revision 3

Transceiver Module

In Radio communication, a transceiver is an electronic device that's a combination of a radio transmitter and a receiver. It can both transmit and admit signals using an antenna, for dispatches purposes. These two affiliated functions are frequently combined in a single device to reduce manufacturing costs. The term is also used for other bias which can both transmit and admit through a communication channel.

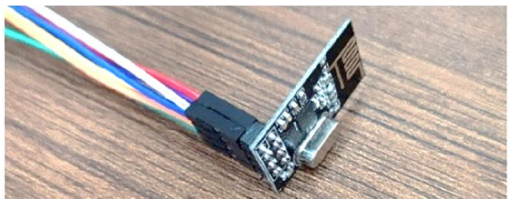

Fig 8. nRF24L01 – 2.4GHz RF Transceiver Module

These RF modules are veritably popular among Arduino potterers. The nRF24L01 is used on a wide variety of operations that bear wireless control. They're transceivers which means that each module can transmit and admit data.

SMART SENSING DEVICES

In this system, using three types of smart detection devices to detect accidents let us take an example of a smoke/gas sensor when a fire accident happened in a public area, especially in a hospital smoke and other poisonous gasses get to blow up. In this project, using a device to detect smoke particles, harmful gases, high temperature, and noise levels for avoiding further casualties.

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The three types of smart detection devices are as follows-

- Smoke/Gas sensing device
- Temperature/Humidity sensing device
- Sound sensing device

Smoke/Gas Sensing Device

Gas and smoke sensing devices are used for the detection of harmful gasses and smoke which outs during accidents in a health care center and the public domain. In this system, two devices are used to detect the presence of smoke, to check the quality of air, and other for the presence of poisonous or in conditions of lockage of harmful gasses.

They are as follows –

- MQ -135
- MQ -2

MQ -135 Smoke/Gas Sensing Device

The Bank detector MQ-135 could be a detector accustomed check the standard of air and it will be shown on display. MQ135 Gas Detector module for Air Quality having Digital in addition as Analog affair. The sensitive material of the MQ135 gas detector is SnO2, which with lower conductivity in clean air.

Fig 9. MQ -135 Smoke/Gas Sensing Device

The analog TTL is operated and operates at3.3 volts, therefore it can be used with the most common microcontrollers. To measure the feasts in PPM (part per melon) the analog leg needs to be used.

MQ-2 Smoke/Gas Sensing Device

Some man-made fields also predict this by installing gas detectors at some point, but this is not effective due to the nature of the gas which can spread rapidly. Gas leaks are one of the frequent occurrences in many man-made mines, which makes some accidents happen due to the presence of gas that cannot be detected by the naked eye.

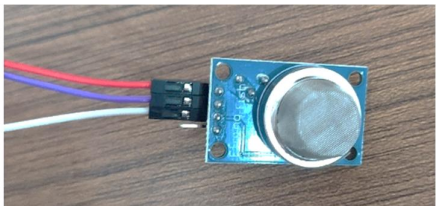

Fig 10. MQ -2 Smoke/Gas Sensing Device

At the time of testing, it may be a different gas configuration but there is still the same correlation, the similarity between the gas's location of interest and the gas leak source. Exploration of gas leaks has been carried out intensively, not only on the gas arrays, but in fact other arrays also began to be carried out in the study.

Working voltage	5 Volt
Working Current	150 mAmp
DOUT	TTL output
AOUT	Analog output

Table 4. Technical Specifications of Smoke/Gas Sensing Device

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Temperature/Humidity Sensing Device

In this system, using a temperature and humidity sensing device to detect a high temperature that occurred during an accident. The temperature/humidity sensor is a device, used to detect the temperature using an electrical signal.

In this system two types of Temperature/Humidity sensing devices, they are as follows –

- DHT 11 Temperature and Humidity sensing device
- KY – 028 Temperature sensing device

DHT 11 Temperature and Humidity Sensing Device

The DHT11 is a generally used temperature and moisture detector. The detector comes with a devoted NTC to measure temperature and an 8- bit microcontroller to affair the values of temperature and moisture as periodical data. The detector is also plant calibrated and hence easy to affiliate with other microcontrollers.

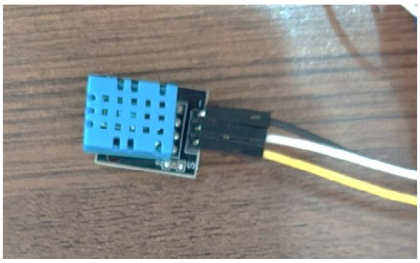

Fig 11. DHT 11 Temperature and Humidity Sensing Device

The DHT11 detector is plant calibrated and labors periodical data hence it's largely easy to set it up. The connection illustration for this detector is shown below. As you can see the data leg is connected to an I/ O leg of the MCU and a 5K pull-up resistor is used.

KY – 028 Temperature Sensing Device

This KY028 digital temperature detector has digital and analog constructions, has a potentiometer to adapt the discovery threshold on the digital interface. The KY028 digital temperature detector measures temperature changes based on thermistor resistance.

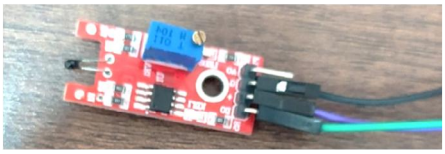

Fig 12. KY- 028 Temperature Sensing Device

This module consists of an NTC thermistor, an LM393 binary discriminating comparator, a 3296W trimmer potentiometer, 6 resistors, 2 LEDs, and 4 manly title legs. The module features analog and digital labors.

Sound Sensing Device

The Sound Detector module can be used for security, switching and monitoring operations. It provides a simple way to detect sound and is commonly used to detect sound intensity. When the detector detects sound, it processes an agreed signal voltage to be passed to a microcontroller and also performs the necessary processing. Its sophistication can be easily adapted for ease of operation. It uses a microphone that provides inputs for the amplifier, peak sensor, and buffer.

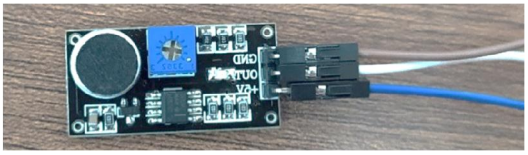

Fig 13. Sound/Noise Sensing Device

When the sound position exceeds the set point, the LED on the module is lit and the housing is set low.

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DEVICE TO GIVE ALERT

The device to give alerts are as followers-

- Nokia LCD Display
- Buzzer

Nokia LCD Display

Nokia 5110 module is a modification that accepts a 35V input. Therefore, there is no need for redundant repositioning devices. The Nokia 5110 Module is a low-cost Snap module consisting of 84 x 48 pixels that can be used to display rich panels and textbook content. PCD8544 is a low power CMOS TV motor/tuner, designed to drive 48 row, 84 column graphic display.

Fig 14. Nokia 5110 LCD Display Module

The output of Arduino is display on. Nokia 5110 LCD display module.

Buzzer

Piezo buzzer is an electronic device commonly used to produce sound. Snippersnapper, simple construction and low cost make it possible to use in colorful activities like car/truck reverse pointer, calculator, ringer, etc. The piezoelectric buzzer can be driven by an oscillating electronic circuit or other audio signal source.

Fig 15. Piezo 5-12V DC -85Db Buzzer Sounder

The electronic piezo buzzer is connected to the relay. Electronic horn Piezo 12V85dB. The Tone Nonstop A buzzer is a mechanical, electromechanical, glam, electromagnetic, electronic or piezoelectric acoustic signal generator.

Relay

A relay is a switch that controls (opens) an electrical circuit. Power status indicator light, release status light off; VCC for system power, JD_VCC for relay power. 5V disconnect relay. The main operation of this device is to make or break the ignition using a signal without any serious impact to turn this device on or off. Pull low, release high.

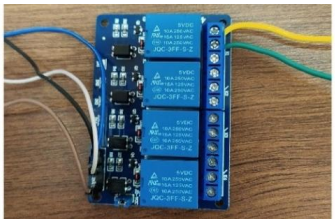

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Fig 16. 4 Channel 5V 10A Relay Module

Operating voltage DC 5V; Detector current 5mA; Typically, open interface outside cargo AC 250V/ 10A, DC 30V/ 10A. Detector Type Low = ground position = sense 0 = logical false| High = force voltage (generally Vcc) = sense 1 = logical true.

V. RESULTS AND DISCUSSION

Observing the result on LCD screen as output of system.

Fig 17. LCD Screen

In fig. 17 the output can observe in screen.

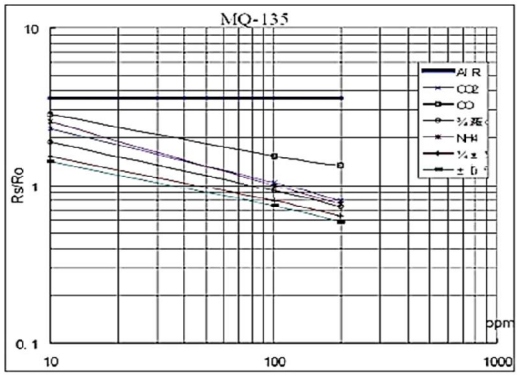

Fig 18. Sensitivity Characteristics MQ-135

- The smoke sensor is used to check the quality of air and it will be shown on display.
- The system give alert when the smoke is detected by the smoke/gas sensor.
- In fig. 18 the threshold value of smoke sensor is 300 ppm.

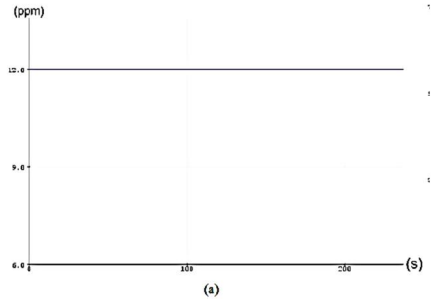

Fig 19. Graph During Normal Conditions

- Fig. 19 can be compared graphically when normal and when there is a gas leak. At point Fig. 19 shows a stable value between 21-24 ppm.

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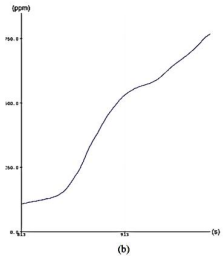

Fig 20. Graph When There Is a Gas Leak

At Fig. 20 shows a change in value that reaches 750 ppm when there is a point that is identified as a gas leak.

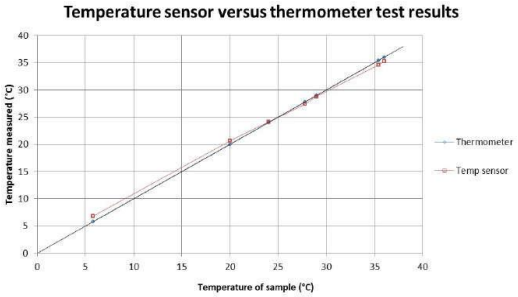

Fig 21. Temperature Sensor Result

- In fig 21. the temperature/humidity sensor is used to check the temperature and it will be shown on display.
- The system give alert when the high temperature is detected by the temperature/humidity sensor.
- The threshold value of temperature sensor is 45 C.

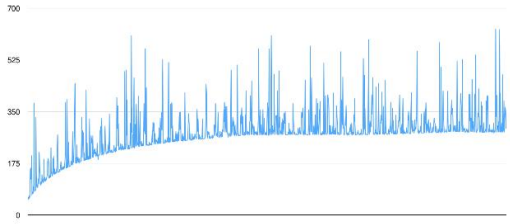

Fig 22. Results for Sound sensor

- In fig 22. the sound/noise sensor is used to check the sound/noise and it will be shown on display.
- The system give alert when the high noise is detected by the sound sensor.
- The threshold value of sound sensor is 65 dB.

Result for Power Consumption of System

Vhr = 0.05volt;
Ihr = 135mA = 0.135Amp;
Phr = Vhr * Ihr = 0.05 * 0.135 = 0.00675 WattsHr
Phr = 6.75 mWattsHr
Current consumption for 24 hours for a day
I = 0.135*24 = 3.24 AmpHr

VI. CONCLUSION

The propose system is used to detect the casualties that happened in the health care and public domain areas. The sensors used in this system detect smoke, hazardous gases, temperature that rises during a fire tragedy. The proposed system is beneficial for the government and health care center. The system is affordable and economic. The system is eco-friendly as

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it uses solar energy to operate. Causalities are reduced and loss of lives are avoided with the proposed system. It can be used in defense and also devote its use to our nation.

Nomenclature

Voc = Open Circuit Voltage
Vmax = Maximum Voltage
Isc = Short Circuit Current
Imax = Maximum Current
Pmax = Maximum Power

FF = Fill Factor
Rin = Radiation
Phr = Power consumption for an hour
Vhr = Voltage consumption for an hour
Ihr = Current consumption for an hour

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BIOGRAPHY

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