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Ethernet Based Home Monitoring System for Elderly Using Wireless Sensors

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***Abstract*- Ethernet Based Home Monitoring System for Elderly using wireless sensors is action behaviour involves functional assessment of daily activities. In Proposed system, it is an intelligent home monitoring system based on ZigBee wireless sensors network using ARM7 has been designed and developed to monitor and evaluate the well- being of the elderly living alone in home environment. We reported a mechanism for estimation of elderly well- being condition based on repetition of daily activities such as staying of each room, going-out and sleep behaviour. Regular usage of house-hold appliances connected through various sensing units, those parameters will be stored in PC and by using Ethernet we can access in internet. The developed system for observing and assessment of daily activities and information of usage of home appliances is updated into webserver by using Ethernet Module. The system interprets all the essential elderly activities such as preparing breakfast/lunch/dinner, showering, rest-room use, dinning, sleeping and self-grooming. Basically, the system function based on the usage data of electrical and non-electrical appliances within a home.**

***Index Terms* – Activities of Daily living, Zigbee, Wireless Sensor Network,Ethernet.**

I. INTRODUCTION

The world population of people over the age of 65 is growing rapidly at a rate of 800,000 per month. As a consequence, the healthcare and elderly-care market already constitutes a major part of the economy and it will only expand in years to come. Anormal person performs daily activities at regular interval of time. This implies that the person is mentally and physically fit and leading a regular life. This tells us that the overall well-being of the person is at a certain standard. If there is decline or change in the regular activity, then the wellness of the person is not in the normal state. Elderly people desire to lead an independent lifestyle, but at old age, people become prone to different accidents, so living alone has high risks and is recurrent.A growing amountof research is reported in recent times on development of a system to monitor the activities of an elderly person living alone so that help can be provided before any unforeseen situation happened.

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Recent advances in sensor technology, cellular networks and information technology promise to improve the well-being of the elderly by assisting them in their everyday activities and monitoring their health status. Thus enabling them to lead their lives to a larger extent independently from healthcare institutions and caretakers.

The developed system is intelligent, robust and does not use any camera or vision sensors as it intrudes privacy. Based on a survey among elderly we find that it has a huge acceptability to be used at home due to non-use of the camera or vision based sensors. The intelligent software, along with the electronic system, can monitor the usage of different household appliancesand recognize the activities to determine the well-being of the elderly.

At the hardware level, wireless sensor network with ZigBee components are connected in the form of mesh topology, and a central coordinator of the sensing units collect data from the sensors connected to various appliances.

II. EXISTING SYSTEM

In Existing System many of the Health Monitoring Systems were came into picture. In Some systems we are connecting different types of sensors such as Temperature sensor, Heart Beat Sensor are attached to the patient who is not well-being [5, 6]. Those sensor parameters can monitor on LCD Display those parameters will be send to taking care person or Doctor through GSM.

There are a number of Systems available on wearable health devicespersonal wellness monitoring[4] and safety integrated with sensors to provide continuous monitoring of person's health related issues and activity monitoring.[5] Also, systems using Zigbee and GSM technology in elderly centre were introduced. Though these devices are for specific purposes, these devices mainly for safety purpose, not concerning about security, privacy and legal sides. Usually people are reluctant to wear a system continuously on their body. So it may not be a feasible option for a healthy elderly people. This situation may be acceptable for a patient under reintegration.

Many of systems for monitoring and well-designed assessment for old-aged people care have been proposed and developed in recent times. Monitoring activities of the person based on camera based sensorsare reported in where the images of the person are taken and analysed [7]. In real practice applications such as surveillance and security make full use of camera based system but for home

monitoring activities it lacks a huge acceptability among the elderly [1, 2].

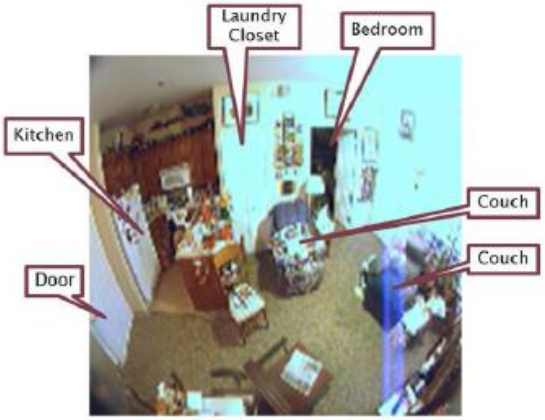

Fig 1: Picture captured using the fisheye camera installed in a living room of a one-bedroom apartment.

We cannot monitor all the daily activities of Well – being person. We can capture the activities of person if he is in living room or bed room. The above figure is Picture captured using the fisheye camera installed in a living room of a one-bedroom apartment. We cannot capture the activities of person if he is in Wash Room or Toilets.

III. PROPOSED SYSTEM

In my proposed system consists of two basic sections those are Transmitter and Receiver sections. At the Transmitter section, Wireless sensor network integrated with Zigbee modules of mesh structure exists capturing the sensor data based on the usage of house-hold appliances [1] andsend the sensor data to receiver section. At the receiver section stores data in the computer system and further data processing can be performed through Ethernet Module. Collected sensor data are of low level information containing only status of the sensor as active or inactive and identity of the sensor. To sense the activity behaviour of elderly in real time, the next level software module will analyse the collected data by following an intelligent mechanism at various level of data abstraction based on time and sequence behaviour of sensor usage.

The Transmitter section of system consists of different sensors interconnected to detect usage of electrical devices and non-electrical devices like bed, chairs and toilets. The fabricated sensing unit communicates at 2.4GHz (Industrial Scientific and Medical band) through radio frequency protocols and provides sensor information that can be used to monitor the daily activities of an elderly person.

The electrical appliances are monitored by the electrical appliance monitoring sensing units. These operate based on the detection of current flow connected to appliances such as microwave, water kettle, toaster, room Heater, television and dishwasher as they are regularly used by the elderly at home.

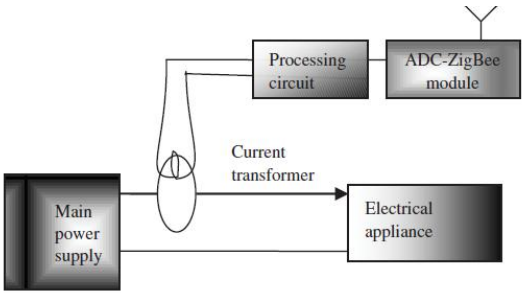

Fig.2. Block diagram representation of interfacing current sensor with ZigBee module

The output of electrical appliance monitoring sensor unit is either ON or OFF based on the use of connected electrical appliance. Normally, one electric sensing unit is required tosense each electrical appliance. In my proposed system, we have used Pressure sensor, Gas Sensor, Tilt Sensor, Humidity Sensor, Temperature sensor [3]. Each sensor connected to different home appliances to monitor daily activities. Based on the usage of home appliances, sensor unit is either ON or OFF. Sensor Unit Information will be send to Receiver section through Zigbee further data processing.

Pressure Sensors are attached to Bed, Chair, and Toilets for monitoring daily activities of elder person. Whenever pressure applied on these appliances, sensor is activated and "PRESSURE SENSOR ACTIVATED" information will be displayed on the LCD display provided at transmitter section. Gas Sensor connected to Gas Cylinder or at Gas stove. It detects the gas whenever they use the stove or opened the regulator. Immediately "GAS SENSOR ACTIVE" information will be displayed on the LCD. For security purpose we have connected alert alarm to system. Whenever gas sensor is active automatically alarm is on to alert the person. The Tilt sensor is using as vibration sensor in our system. In Tilt sensor has a mercury ball whenever vibration is occurred the mercury ball is moving inside and conducted. Temperature and humidity sensing units are used to record the ambient readings of room for analysing the data. Contact sensing units are fixed to the fridge and grooming cabinet of the elderly home to detect the open and close of the door operations. Events related to these actions were effectively recorded to recognize thecorresponding activities.

The collected information from sensing units in the Transmitter section is send to receiver section through zigbeeand it will be stored in PC and send to internet through Ethernet Module[8]. The main aim of our proposed system is wellness determination of the person; it means how"healthy"theelderlylivingaloneisabletoperformhis essentialdailyactivitiesintermsoftheusageofthehouse-holdappliances. Fig:5& Fig: 6 Illustrates hardware design of transmitter section and receiver section of proposed system.

IV. DESIGN OF PROPOSED SYSTEM

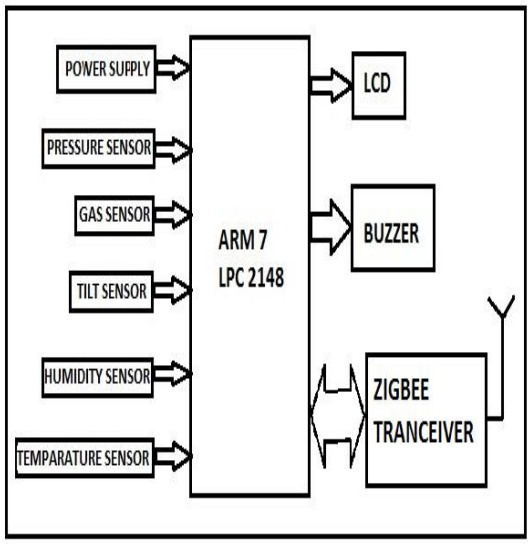

Fig 3: Block Diagram of Transmitter Section

In this paper we are proposing an advanced wireless system for home monitoring to update the usage of home appliances in the transmitter section immediately and updating it to the web server. Block diagram of Transmitter Section is shown in Figure 3. Here we have Transmitter section and the Receiver section. In the Transmitter section first step is to initialize the zigbee & LCD to transmit and to display the sensor values respectively. These sensed analog values are converted in to digital values and those values are not displayed on the LCD which displays only which sensor activated and the same information is sent through zigbee to Receiver Section directly. When we use the Home appliances the corresponding sensors sensed, those data will be displayed and will be sent to the Receiver section for monitoring purpose, those collected information from sensors are stored in PC and updating it to the web server through Ethernet module.

Arm7TDMI: ARM stands for Advanced RISC Machines. An ARM processor is basically any 16/32bit microprocessor designed and licensed by ARM Ltd, a microprocessor design company headquartered in England, founded in 1990 by Herman Hauser [9]. A characteristic feature of ARMprocessors is their low electric power consumption, which makes them particularly suitable for use in portable devices. It is one of the most used processors currently in the market.

Microcontroller: The microcontroller is the heart of the embedded system. It constantly monitors the digitized parameters of the various sensors and verifies them with the predefined threshold values. It checks if any corrective action is to be taken for the condition at that instant of time. In case such a situation arises, it activates the actuators to perform a controlled operation.

Temperature sensor: Temperature sensor is used to sense the temperature of a medium. Temperature sensors having temperature-dependent properties which can be measured electrically include resistors, semiconductor devices such as diodes, and thermocouples. A resistance thermometer has a sensing resistor having an electrical resistance varying with temperature.

Humidity sensor: There are various devices used to measure and regulate humidity. A device used to measure humidity is called a psycho meter or hygrometer. Humidity sensors have gained increasing applications in industrial processing and environmental control. For manufacturing highly sophisticated integrated circuits in semiconductor industry, humidity or moisture levels are constantly monitored in wafer processing. There are many domestic applications, such as intelligent control system of the living environment in buildings, cooking control for microwave ovens, and intelligent control of laundry etc.

LCD Display Section: This section is basically meant to show up the status of the project. This project makes use of Liquid Crystal Display to display / prompt for necessary information.

Zigbee transceiver: Transceiver is a device which acts as both transmitter and receiver. This operates with 2.8-3.4V. Range of the transceiver module is 30-70m in urban areas and 1-1.5km in outdoor (LOS). The transceiver has an on-chip wire antenna and it operates at a frequency of 2.4GHz.The data received from the microcontroller is organized based on the ZIGBEE protocol standards and then modulated. Along with the data, source address and destination address are added and sent.

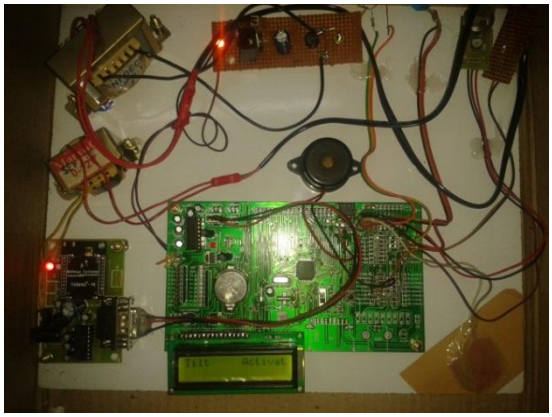

Fig 4:Hardware design of Transmitter Section

Gas Sensor: They are used in GAS leakage detecting equipment's in family and industry, are suitable for detecting of LPG, i-butane, propane, methane, alcohol, Hydrogen, smoke.

Force or Pressure Sensor: A force-sensing resistor is a material whose resistance changes when a force or

pressure is applied. They are also known as "force-sensitive resistor".

Tilt Sensor: Tilt sensors allow you to detect orientation or inclination. They are small, inexpensive, low-power and easy-to-use. If used properly, they will not wear out. Sometimes they are referred to as "mercury switches", "tilt switches" or "rolling ball sensors" for obvious reasons.

In the Receiver section initially we need to initialize the zigbee and LCD to receive and to display the sensor values which are received from the Transmitter sections. Block diagram of Receiver section is shown in Figure 5.

All the sensor values which are transmitted from the Transmitter section are received in this Receiver section through zigbee and updated Web server through an Ethernet module and PC which can be monitored from anywhere on the web.

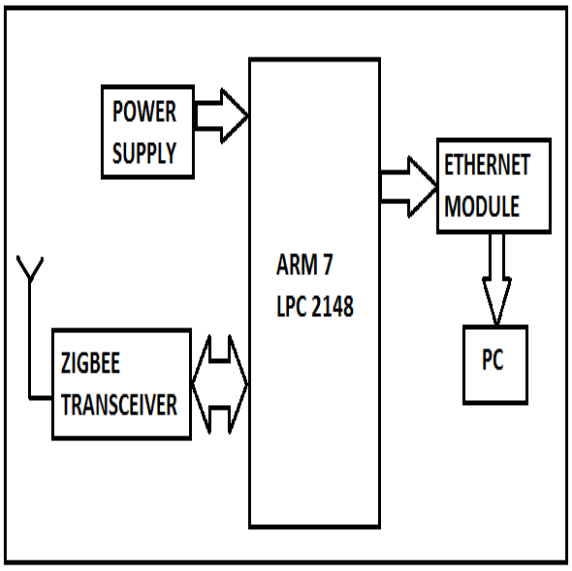

Fig 5: Block Diagram of Receiver Section

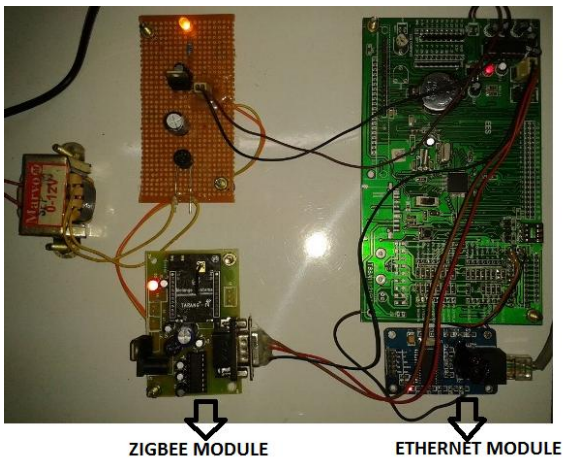

Fig 6: Hardware Design of Receiver Section

POWER SUPPLY: In this project we required operating voltage for ARM controller board is 12V. Hence the 12V D.C. power supply is needed for the ARM board. This regulated 12V is generated by stepping down the voltage from,30V to 18V now the step downed AC voltage is being rectified by the Bridge Rectifier using 1N4007 diodes. The rectified, filtered D.C. voltage is fed to the Voltage Regulator. This voltage regulator provides/allows us to have a Regulated constant Voltage which is of +12V. The rectified; filtered and regulated voltage is again filtered for ripples using an electrolytic capacitor 100µF. Now the output from this section is fed to microcontroller board to supply operating voltage.

V. SENSORS & MODULES

A transducer is a device which measures a physical quantity and converts it into a signal which can be read by an observer. It can also be read by an instrument. The sensors used in this system are:

A. Gas Sensor
B. Temperature Sensor
C. Humidity Sensor
D. Tilt Sensor
E. Force or Pressure Sensor

A. Gas sensor:

They are used in GAS leakage detecting equipment's in family and industry, are suitable for detecting of LPG, i-butane, propane, methane, alcohol, Hydrogen, smoke.

Fig 6: GAS Sensor

Standard circuit:

Standard measuring circuit of MQ-135sensitive components consists of 2 parts. One is heating circuithaving time control function. The second is the signal output circuit; it can accurately respond changes of surface resistance of the sensor.

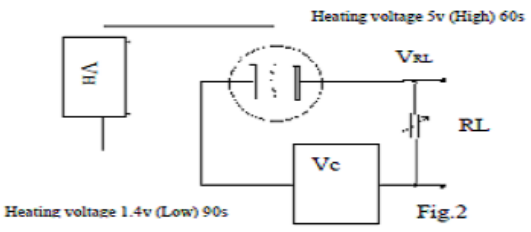

Fig 7: Standard Circuit

Specifications:

- Semiconductor Type GAS SENSOR.

- High Sensitivity
- Stable and Long Life
- Detection Range: 10 - 300 ppm NH3, 10 - 1000 ppm Benzene, 10 - 300 Alcohol
- Heater Voltage: 5.0V
- Dimensions: 18mm Diameter, 17mm High excluding pins, Pins - 6mm High
- Temperature range: -20deg.C to +40 deg. C

B. Temperature sensor:

Thermistors are inexpensive, easily-obtainable temperature sensors[3]. They are easy to use and adaptable. Circuits with thermistors can have reasonable out voltages - not the millivolt outputs thermocouples have. Because of these qualities, thermistors are widely used for simple temperature measurements. They're not used for high temperatures, but in the temperature ranges where they work they are widely used..

Thermistors are temperature sensitive resistors. All resistors vary with temperature, but thermistors are constructed of semiconductor material with a resistivity that is especially sensitive to temperature. However, unlike most other resistive devices, the resistance of a thermistor decreases with increasing temperature.

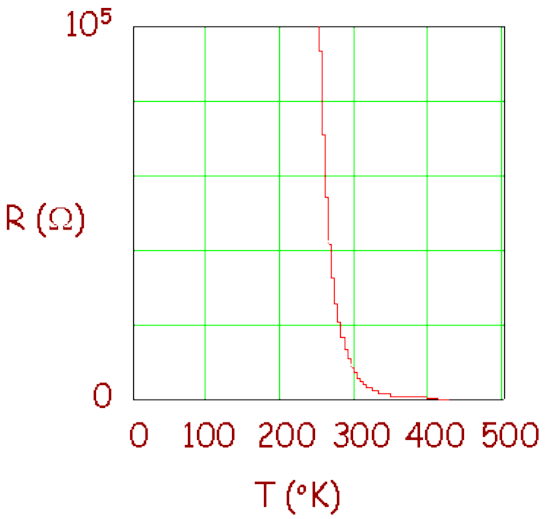

Fig 8: Temperature versus Resistance

Fig 8: Illustrates graph of resistance as a function of temperature for a typical thermistor. Notice how the resistance drops from 100 k**W**, to a very small value in a range around room temperature. Not only is the resistance change in the opposite direction from whatyou expect, but the magnitude of the percentage resistance change is substantial.

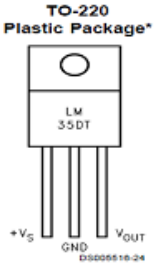

Fig:9 Temperature Sensor

Features:

- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10.0 mV/°C scale factor
- 0.5°C accuracy guarantee able (at +25°C)
- Rated for full −55° to +150°C range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than 60 µA current drain
- Low self-heating, 0.08°C in still air
- Nonlinearity only ±1⁄4°C typical
- Low impedance output, 0.1 W for 1 mA load

C. Humidity sensor:

In scientific and industrial environments humidity sensors are highly appreciated devices as part of their control or monitoring systems as they allow factory operators and scientists make sure that they are operating with chemical compounds or other kind of elements in an environment that complies with the adequate levels of humidity.

Humidity is the content of water vapour in air and we are quite used to learning about it every morning as we listen to the weather forecast before going to work. Just as an excess of humidity makes it difficult to keep our hair straight and we suffer from frizz, in laboratories and industrial environments such as pet and human food industries, leather industries, coffee bean grinding industries and beer manufacturing an excess of humidity can be really serious. Macromolecule Humid resistance sensor (GY-HR10X), it's a new kind of humid resistance sensor; it has a wide range of humidity, fast respond, high sensitivity, reliable performance consistency characteristics.

Humidity can have a serious impact on chemical and industrial processes, ruining hours and hours on end of production and scientific efforts and this is why these instruments are so valuable.

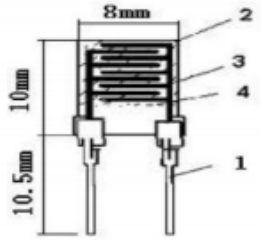

Fig: 10 Humidity Sensor

D. Pressure or Force Sensor:

A force-sensing resistor is a material whose resistance changes when a force or pressure is applied. They are also known as "force-sensitive resistor".

Force-sensing resistorsconsist of a conductive polymer, which changes resistance in a predictable manner following application of force to its surface. They are normally supplied as a polymer sheet or ink that can be applied by screen printing. The sensing film consists of both electrically conducting and non-conducting particles suspended in matrix. The particles are sub-micrometre sizes, and are formulated to reduce the temperature dependence, improve mechanical properties and increase surface durability. Applying a force to the surface of the sensing film causes particles to touch the conducting electrodes, changing the resistance of the film. As with all resistive based sensors, force-sensing resistors require a relatively simple interface and can operate satisfactorily in moderately hostile environments. Compared to other force sensors, the advantages of FSRs are their size (thickness typically less than 0.5 mm), low cost and good shock resistance. However, FSRs will be damaged if pressure is applied for a longer time period (hours). A disadvantage is their low precision: measurement results may differ 10% and more.

Fig 11: Pressure or Force Sensor

E. Tilt Sensor:

Tilt sensors sallow you to detect orientation or inclination. They are small, inexpensive, low-power and easy-to-use. If used properly, they will not wear out. Their simplicity makes them popular for toys, gadgets and appliances. Sometimes they are referred to as "mercury switches", "tilt switches" or "rolling ball sensors" for obvious reasons.

They are usually made by a cavity of some sort (cylindrical is popular, although not always) and a conductive free mass inside, such as a blob of mercury or rolling ball. One end of the cavity has two conductive elements (poles). When the sensor is oriented so that that end is downwards, the mass rolls onto the poles and shorts them, acting as a switch throw.

Tilt switches used to be made exclusively of mercury, but are rarer now since they are recognized as being extremely toxic. The benefits of mercury are that the blob is dense enough that it doesn't bounce and so the switch isn't susceptible to vibrations. On the other hand, ball-type sensors are easy to make, wont shatter, and pose no risk of pollution

Fig 12: Tilt Sensor

4.1 ETHERNET MODULE:

The ENC28J60 is a stand-alone Ethernet controller [8] with an industry standard Serial Peripheral Interface (SPI™). It is designed to serve as an Ethernet network interface for any controller equipped with SPI.

The ENC28J60 meets all of the IEEE 802.3 specifications. It incorporates a number of packet filtering schemes to limit incoming packets. It also provides an internal DMA module for fast data throughput and hardware assisted IP checksum calculations. Communication with the host controller is implemented via two interrupt pins and the SPI, with data rates of up to 10 Mb/s. Two dedicated pins are used for LED link and network activity indication.

Ethernet Controller Features

- IEEE 802.3 compatible Ethernet controller
- Integrated MAC and 10BASE-T PHY
- Receiver and collision squelch circuit
- Supports one 10BASE-T port with automatic polarity detection and correction
- Supports Full and Half-Duplex modes
- Programmable automatic retransmit on collision
- Programmable padding and CRC generation
- Programmable automatic rejection of erroneouspackets
- SPI™ Interface with speeds up to 10 Mb/s

Medium Access Controller (MAC) Features

- Supports Unicast, Multicast and Broadcast
- packets
- Programmable receive packet filtering and Wake-up host on logical AND or OR of the Following:
  - Unicast destination address
  - Multicast address
  - Broadcast address
  - Magic Packet™
  - Group destination addresses as defined by64-bit hash table

- Programmable pattern matching of up to64 bytes at user-defined offset
- Loopback mode

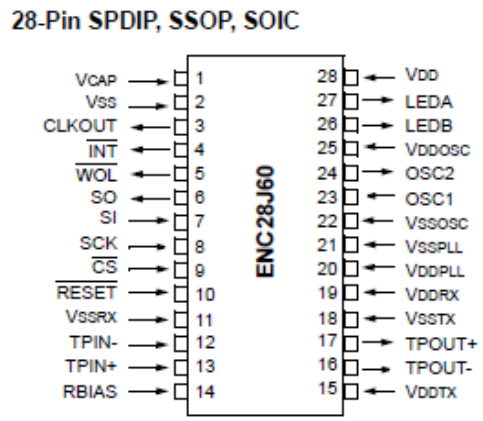

Fig 13: Pin diagram of ENC28J60 Ethernet module

VI. RESULTS

The outputs of implementing System are observed on LCD display which is connected to transmitter section and Updated Software which was installed in PC and then the same data will be send to the web server. Here we have taken a domain web site which is "http://www.stupros.com/site/live8.php "in which the last updated information will be displayed. Whenever the sensors activated, sensor information will be displayed on the LCD, information with time will be displayed on the software and web server.

Fig 14: Illustrates LCD displays the "Pressure Activated. It doesn't display activation time of sensor. Fig 15: Java programmed software it displays activated sensors with their activation date and Time information. Fig 16: Output displayed on Web page

Fig 14: Showing the output on LCD Display

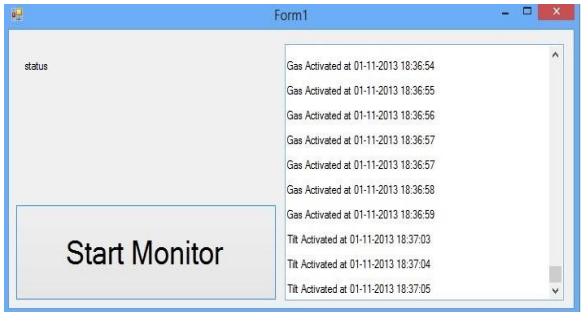

Fig 15: Showing Output in PC with Date &time

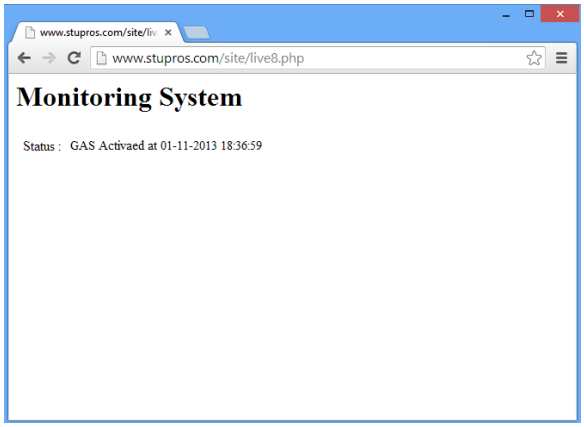

Fig: 16 Show the output on web page

VII. CONCLUSION

Ethernet Based Home Monitoring System for ElderlyUsing Wireless Sensors is effective to monitor the daily activities of elders. It means we are determining the wellness of the elders who are living alone. Using Ethernet is in our project is advanced. The person who take cares the elder who is living alone, the taking care person can check the daily activities of the elder who is performing his daily activities in time or not. Connecting sensors to home appliances, the sensor information will be sending from transmitter section to receiver section through zigbee. In future, monitor the patient's physiological parameters like heart beat and temperature along with this system

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