Smart Sensory Furniture

Mrs. Mettilda Mary[1], N Ramya[2], P Priyadharshini[3], S Srinithi[4]

[1]Assistant professor, Department of information technology
[2,3,4]UG Students, Department of information technology, Sri Ramakrishna Engineering College Vattamalaipalayam, Coimbatore-641022

Abstract - *The main objective behind the Smart sensory Furniture project is that, by integrating networked sensors and actuators in objects like furniture, a system can be built providing supervision similar to a caregiver. Implemented a mechanism for estimation of elderly well-being condition based on usage of household appliances connected through various sensing units. Our project aims to achieve the concept of smart sensing furniture a reality. This concept intends to provide furniture of augmented functions within the scope of safety, prevention and eldercare. To develop a hardware infrastructure, consisting of sensors and actuators integrated into furniture. Sensors capture the information of interaction between people and furniture, and between people and the environment. To create a communication structure that allows sending the information wirelessly between sensors. Sensor can be arranged in different parts of furniture or located in different pieces of furniture. Furniture can be fixed or mobile. To build middleware for communications infrastructure. This infrastructure must create a set of services for the proper management of the furniture, monitoring and control, providing smart and autonomous capabilities.*

***Key Words*: Health monitoring, Temperature, Heartbeat rate, Respiration rate, Cloud, Thing Speak, GSM, Caretaker, Doctor**

1. INTRODUCTION

A normal 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. [1]A growing amount of 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.

Wireless sensor network have become very important because of their ability to monitor and manage situational information in number of intelligent services. In this technological world internet technologies and WSN are expanding rapidly. Thus home environment has seen a rapid introduction of network enabled digital technology, which offers various newly introduced opportunities for the connectivity of devices within the home for purpose of home automation. For reducing the energy consumption wireless sensor networks (WSNs) is recommended everywhere. [8] WSN is widely used for environmental monitoring, health monitoring, home automation and industrial monitoring. This system is designed by the integration of WSNs with aurduino and it is used to communicate with the user.

The developed software system continuously reads the data from the coordinator and efficiently stores on the system for further data processing in real time. [9]The data processing involves steps for wellness check based on the knowledge of daily activities performed in conjunction with the usage of house-hold appliances, for predicting change in the daily activity pattern of the system. In this system, a required number of sensors for monitoring the daily activities of the elderly have been used. Increase of a number of sensors increases the cost of the system and may also complicate the installation issues. The ultimate goal of personal wellness systems is to provide care for elderly people in the right time no matter where they live, but technology could assist with transitions from one level of care to the next and help prevent premature placement in expensive assistance domains Activity recognition and Wellness determination are two functions to be done in a timely manner rather than offline. Hence, real-time processing of data is a must for recognizing activity behaviour and predicting abnormal situations of the elderly. To deal with issues such as monitoring the daily activities, performance tracking of normal behaviour and well-being of the elderly living alone a system which is noninvasive, flexible, low-cost and safe to use is designed and developed. An initial decline or change in regular daily activities can be identified by the home monitoring system and trigger messages to the appropriate care provider about the changes in the functional abilities of the elderly person.

2. RELATED WORK

Prabal Verma and Sandeep K Sood [6] proposed a Fog Assisted- IoT Enabled Patient Health Monitoring In Smart Phones. This model uses advanced techniques and services such as embedded data mining, distributed storage, and notification services at the edge of the network. Event triggering based data transmission methodology is adopted to process the patient's real-time data at Fog Layer. Rasha Talal Hameed [1]developed a Health Monitoring System Based on Wearable Sensors and Cloud Platform framework using e-health sensor shield associated with a cloud platform which gathers the data from the sensors. The sensors measure various parameters, such as a glucometer, airflow and patient position which are transmitted via microcontroller by a gateway to a cloud storage platform. The data collected in the cloud platform is accessible for further handling, for the investigation of some correlations among measured parameters and health state of the patients. Alexander Archip [2,3]proposed a system for remote patient monitoring. In this system patients are monitored in an ICU until physically stable, after which are discharged to a ward for further evaluation and recovery.

3. DESCRIPTION OF WORK

The SSF (Smart Sensory Furniture) project aims to advance towards the support of people with special needs, with a strong focus on the elderly. The basic idea behind the SSF project is that by integrating networked sensors and actuators in objects like furniture, a system can be built providing supervision similar to a caregiver. The sensors can monitor the users and their environment, then the intelligent system can identify the main features of the context (i.e., what is actually happening), and finally can decide on the actions to take that will benefit the users in this context. In summary, the SSF project aims to achieve the following:

(1) To make the concept of smart sensing furniture a reality. This concept intends to provide furniture of augmented functions within the scope of safety, prevention and eldercare

(2) To develop a hardware infrastructure, consisting of sensors and actuators integrated into furniture. Sensors capture the information of interaction between people and furniture, and between people and the environment.

(3) To create a communication structure that allows sending the information wirelessly between sensors. Sensor can be arranged in different parts of furniture or located in different pieces of furniture. Furniture can be fixed or mobile.

(4) To build middleware for communications infrastructure. This infrastructure must create a set of services for the proper management of the furniture, monitoring and control, providing smart and autonomous capabilities.

4. BLOCK DIAGRAM

The primary aim of the system is to develop a system that gives a virtual feeling of a caretaker being present with the elderly at home. Although a complete replacement isn't possibly feasible, this system gives a near end alternative. Smart Sensory Furniture will be able to send an alert message to the caretaker of the elderly when he walks away from bed during the night or in case of emergency situations such as rise or fall of temperature or liquid oozing out from the elderly during urination or vomiting. The system neither needs an extra build of designing a new furniture nor modeling of the existing furniture set. This system enables us to give an add on to the existing furniture such that best possible outcome can be achieved with low cost.

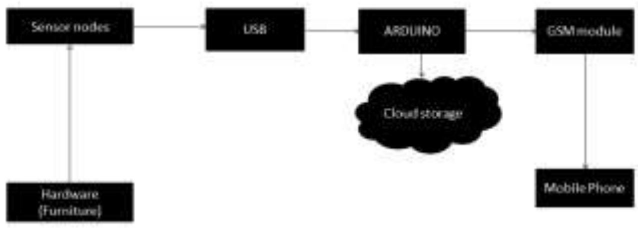

Fig -1: Block Diagram

5. DEVICES USED

The major components of this project are listed as,

- Arduino Mega
- PIR sensor (BMP180)
- Ultrasonic sensor
- Conductive Yarn
- SPO2
- GSM (SIM800A)
- ThingSpeak

5.1 ARDUINO MEGA

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or Breadboards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

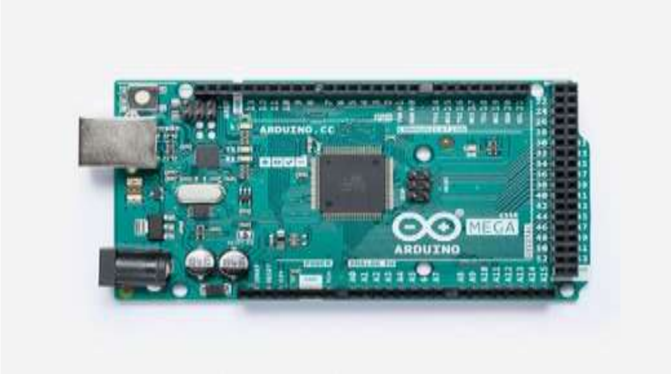

Fig -2: Arduino Mega

5.2 PIR SENSOR

PIRs are made of pyroelectric sensors, a round metal with a rectangular crystal in the center. PIR sensor with an Arduino board can get serial data through it. The PIR sensor basically works on the thermal radiation which is being emitted by the body of humans as well as animals.

The BMP180 is the next-generation of sensors from Bosch, and replaces the BMP085 which is used to sense the pressure and temperature.

Fig -3: PIR Sensor

5.3 ULTRASONIC SENSOR

Ultrasonic sensor is used to calculate the distance of the people from the furniture. The working principle of ultrasonic sensor is that, it emit short, high-frequency sound pulses at regular intervals. These propagate in the air at the velocity of sound. If they strike an object, then they are reflected back as echo signals to the sensor, which itself computes the distance to the target based on the time-span between emitting the signal and receiving the echo.

Fig -4: Ultrasonic Sensor

5.4 CONDUCTIVE YARN

Conductive yarns are used for integration of sensors and other electronic devices with textile fabrics through weaving, knitting, braiding or embroidery processes They are used like a circuiting wires in textile so that the wearable devices provide more comfort zone to the people who wear it. Conductive yarns are used to sense the moisture in the bed or furniture in which the elderly people rests most of the time. If moisture is sensed, then the arduino takes over the control and checks for the threshold value limit according to which it decides if to send an alert to the caretaker. Conductive yarn is used to sense the moisture in the bed or furniture in which the elderly people rests most of the time.

Fig -5: Conductive Yarn

5.5 SPO2 MAX30100 SENSOR

The MAX30100 is an integrated pulse oximetry and heart-rate sensor solution. It operates from 1.8V and 3.3V power supplies. SPO2 measures pulse and oxygen saturation in blood. The respiration rate is calculated by using heart rate.

Arduino Uno SPO2 sensor

- VIN ->5V
- GND -> GND
- SCL -> SCL
- SDA -> SDA

Fig -6: SPO2 MAX30100

5.6 GSM

A GSM Module is basically a GSM Modem (like SIM 800) connected to a PCB with different types of output taken from the board – say TTL Output (for Arduino, 8051 and other microcontrollers) and RS232 Output to interface directly with a PC (personal computer). The board will also have pins or provisions to attach mic and speaker, to take out +5V or other values of power and ground connections. These type of provisions vary with different modules. The program has two objectives as described below:-

1) Send Alert using Arduino and GSM Module – to a specific mobile number inside the program

2) Receive Alert using Arduino and GSM Module – to the SIM card loaded in the GSM Module.

FIG -7:GSM

5.7 THINGSPEAK

Thingspeak is an IOT analytics platform service that allows to aggregate, visualize and analyze live data streams in the cloud. Thingspeak provides instant visualizations of data posted by our devices to Thingspeak. Thingspeak enables sensors to send data to the cloud where it is stored in either a private or a public channel. Thingspeak stores data in private channels by default, but public channels can be used to share data with others. Thingspeak requires a user account and a channel. A channel is where we send data and where Thingspeak stores data. Each channel has up to 8 data fields, location fields, and a status field. We can send data every 15 seconds to Thingspeak, but most applications work well every minute.

6. MODULES DESCRIPTION

6.1 ARDUINO PIN CONFIGURATION MODULE

Arduino mega is used in this module. It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. Begin a serial communication by setting the rate to 9600 bits/second. Now, the data sent from the sensory nodes will be given as an input for processing through configured pins

6.2 SENSORY MODULE

In this module the sensory nodes are collectively configured to the Arduino board. The sensory nodes are the combination of sensors. The sensors are BMP180, Ultrasonics, SPO2, and Conductive yarn. The following f shows Arduino pin configuration with BMP180 sensor. The connections from the UNO to the sensor board are:

- UNO +5V to sensor board VCC
- UNO GND to sensor board GND
- UNO pin A4 to sensor board SDA
- UNO pin A5 to sensor board SCL

This confirmation is same as SPO2. Conductive yarn is connected to the Arduino board. The connections to the Arduino and Ultrasonics are:

- VCC -> Arduino +5V pin
- GND -> Arduino GND pin
- Trig -> Arduino Digital Pin 2
- Echo -> Arduino Digital Pin 2

This sensory nodes outputs are gives as input to the Arduino.

6.3 ARDUINO IMPLEMENTATION MODULE

We integrate all the sensory module output via the input pins. It checks whether output from sensors exceed or lower from the given threshold values. The threshold values are set to every sensor. The threshold values have minimum and maximum rate. The values are

- Temperature (normal body temperature)
- Pressure (Atmospheric pressure)
- Distance (<10cm)
- Moisture (>5)
- Heart rate (62-77 bpm)
- Respiration rate (12-20 bpm)

International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 04 | Apr 2019 www.irjet.net p-ISSN: 2395-0072

If it exceeds then the alert message is send to the care taker. Then the caretaker is able to find the status of the patient and to know what treatment was needed for that patient.

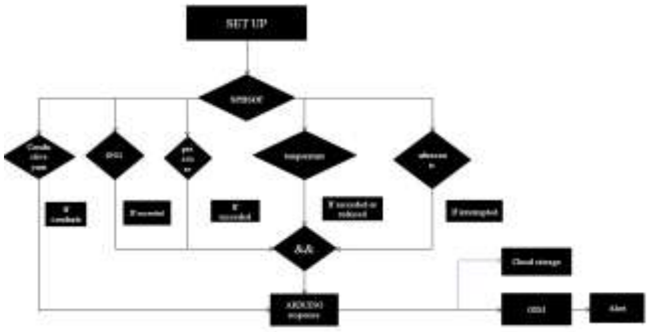

Fig -8:Flow Chart

6.4 GSM MODULE

The alert message from the Arduino is send to the care taker mobile as SMS notifications. So, the care taker will know about liquid oozage, patient off the bed and temperature of patient body increase or decreased. The connections to the arduino are GSM Tx –> Arduino Rx and GSM Rx –> Arduino Tx. Tx is a transmitter pin and Rx is the receiver pin. GSM is send notification to the specified mobile phone. It does not need any internet connection. It sends a normal message to the care taker. GSM works all over india. So we can send SMS notification within that range and without internet connection.

6.5 CLOUD STORAGE MODULE

Cloud is used for storing sensory data. ThingSpeak is an IoT analytics platform service that allows to aggregate, visualize and analyze live data streams in the cloud. ThingSpeak provides instant visualizations of data posted by our devices to ThingSpeak. ThingSpeak enables sensors to send data to the cloud where it is stored in either a private or a public channel. ThingSpeak stores data in private channels by default, but public channels can be used to share data with others. Once created the Thingspeak account, thingspeak plateform provides channel id and write API key. The channel id and write API key is used in Arduino program for updating and storing the sensory data.

7. WORKING

The sensors are placed at the respective locations on the human body and are connected to the Arduino Mega board. For temperature and pressure sensor output from BMP180 is converted to digital form with the help of SDA and SDL pins of Arduino board. The distance is measured by the Ultrasonic sensor. It helps to find the distance between the patient and furniture. It is done by connecting trigger and echo pin of the ultrasonic sensor to Arduino board. Conductive yarn is connected to the Arduino board for measuring moisture presence on the furniture. SPO2 sensor pins SDA and SDL are connected to the Arduino pins SDA and SDL respectively for calculating patient heartrate and respiration rate. SPO2 is placed on a finger. A small beam of light pass through the blood in finger, measuring the amount of oxygen. SPO2 does this by measuring changes in light absorption in oxygenated or deoxygenated blood. This is a painless process. The pulse oximeter will thus be able to tell oxygen saturation levels along with heart rate. Heart rate is fluctuates slightly in coordination with respiration rate, rising on inhalation and falling on exhalation. And it can measure respiration rate from that count. In Arduino the threshold values are specified and programmed. If the threshold values are exceeded or reduced, Arduino triggers the notification to the caretaker by using GSM module. GSM transmitter and receiver pins are connected to the Arduino transmitter and receiver pins. Adapter is used for power supply in GSM module. Arduino outputs are send to the GSM receiver pin. The notifications are send to the caretaker mobile via SMS. All the values taken from the sensors are stored in cloud. Thingspeak provides the facility to store, analyze and visualize the stored data in cloud.

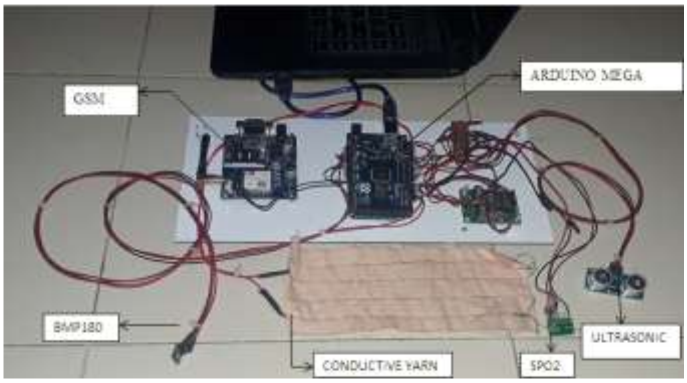

Fig -9:System Setup

8. CONCLUSIONS

SSF systems require the use of sensors that seamlessly monitor the users and their environment in order to anticipate their needs and provide the necessary support and assistance in a non-invasive way. Sensing accuracy is essential to develop reliable systems, whereas transparency and invisibility greatly contribute to the sense of comfort and lack of intrusiveness. With the SSF project, we have taken the first steps toward the creation of smart environment platforms that deliver both, sensing accuracy and system transparency through the seamless integration of sensors in everyday objects like pieces of furniture.

In this paper we have shown that sensors in upholstered furniture can measure certain variables beyond the reach of remote sensing, or at least they can provide better accuracy, since they can get in direct contact with or very close to the user. Examples of these sensors are temperature, weight, level of activity/movement and moisture. At the same time, any kind of furniture can improve the information about the user context, and it is a great place to 'hide' the system hardware including sensors and communication nodes. The complete system design has been described including the node mesh details, as well as the type of sensors and actuators that have been used in SSF. Enabling platforms such as SSF allows us to investigate and address important practical issues such as integration, sensing problems, size, cost and power consumption and is affordable. This system ensures safety measures for people in case of abnormal activities encountered while he stays alone or when everybody is asleep.

9. OUTPUT

FIG -10: ThingSpeak Fields

FIG -11: Channel Status

FIG -12: SMS Notification

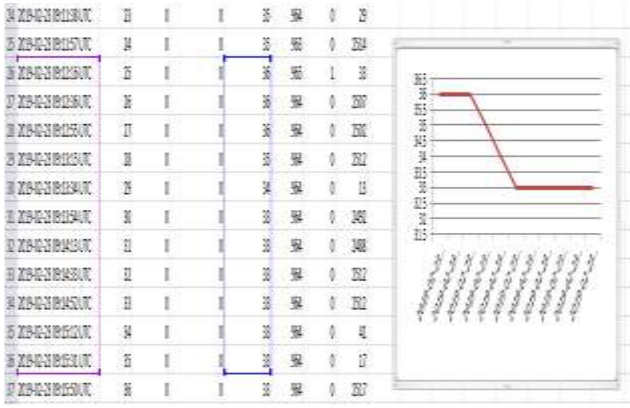

FIG. 13: Excel Report

10. REFERENCES

[1] Rasha Talal Hameed, Omar Abdulwahabe Mohamad, Nicolae Tapus,"Health Monitoring System Based On Wearable Sensors And Cloud Platform", IEEE 2016.

[2] Alexander Archip, Nicolae Botezatu, Elena Serban, Paul-Corneliu Herghelegiu, Andrei Zala,"An IoT Based System For Remote Patient Monitoring", IEEE 2016.

[3] Jayeeta Saha, Arnab Kumar Saha, Aishwarya Chatterjee, Suryash Agrawal, Ankita Saha, Avirup Kar, Himadri Nath Saha,"Advanced Iot Based Combined Remote Health Monitoring Home Automation And Alarm System", IEEE 2018

[4] Veena Tripathi, Faizan Shake, "Monotoring Health Care System Using Internet Of Things – An Immaculate Pairing", IEEE 2017

[5] Prabal Verma, Sandeep K Sood," Fog Assisted- IoT Enabled Patient Health Monitoring In Smart Phones", IEEE 2018.

[6] Vikas Vippalapalli, Snigdha Ananthula, "Internet Of Things (IoT) Based Smart Health Care System", IEEE 2016.

[7] Nagender Kumar Suryadevara, Subhas Chandra Mukhopadhyay, "Wireless Sensor Network Based Home Monitoring System for Wellness Determination of Elderly", IEEE Sensors Journal, Vol. 12, No. 6, June 2012

[8] Hyun Jae Baek, Gih Sung Chung, Ko Keun Kim, and Kwang Suk Park, "A Smart Health Monitoring Chair for Nonintrusive Measurement of Biological Signals", IEEE Transactions On Information Technology In Biomedicine, Vol. 16, No. 1, January (O. C.Santos, 2016) (O. C.Santos, 2016) (O. C.Santos, 2016) (O. C.Santos, 2016)2012

[9] H.Ghayvat, J.Liu, S.C.Mukhopadhyay, X.Gui, "Wellness Sensor Networks: A Proposal and

Implementation for Smart Home for Assisted Living", IEEE Sensors Journal 2015

[10] O. C. Santos, R. Uria-Rivas, M. C. Rodriguez-Sanchez, J. G. Boticario, "An open sensing and acting platform for context-aware affective support in ambient intelligent educational settings", IEEE Sensors J., vol. 16, no. 10, pp. 3865-3874, May 2016.