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Research Article

IoT Solution for Elderly Individual with Independent Lifestyle

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Abstract

Internet of things plays a major role in the health care domain, It not only helps in monitoring the patient continuously but also useful in drawing inferences from those information which will be helpful to treat the patient with appropriate treatment, This work aims at delivering at most care to the elderly people who would like to live independent living, the idea is deploying the sensors in the places where the individual lives and monitoring their activities through internet of things ,the data acquired are saved in the IoT cloud that can be used to draw some inferences about their health behaviour and daily activities through data analytics , those data will be useful for the doctors to understand the elderly people health conditions and the same will be intimated to the care takers under the circumstances when the immediate attention is needed.

Keywords: *Internet of things, cloud, Data analytics, sensors, health care*

Introduction

The average life time of human increases and hence more health care services are needed, and the services are costlier than ever, Day by day the diseases are also increasing Healthcare services are costlier than ever, Elderly people [1] should not go out of reach because they are more prone to diseases, IoT is technology which helps to rescue the world from this despair. even though the technology cannot stop people from getting old and eradicate diseases at once but it can make the service cheaper and easier to the people, largest portion of medical bills is for diagnosis the patient, for all the diagnosis people have to go to the hospital but with the improvement of the technologies they can be diagnosed from being at home [10], if the diagnosis are done correctly in the due time then most of the hospitalization can be avoided

Internet of Things has made a great revolution in many domains, health care is not an exception. It helps the doctor greatly, medical workers and also the patients, and help them to do the things fast and improves the quality of treatment at reduced cost [3]. Remote monitoring [6] of the patients through connected devices and sensors [2] saves many lives by diagnosing the problem earlier and also alert the medical team to treat the patient in due time which avoids many deaths

Smart phone app and the connected devices [5] acquire the patient medical data and transmit the same to the physicians Centre of Connected Health Policy reports that there is 50% reduction in 30-day readmission rate in heart failure patients due to the implementation of tele-treatment and monitoring [6].

The IoT device gathers and transfers health data [9] to the centralized cloud and can be shared to the concerned persons, like medical team [8], insurance agency, they have the privilege to see all those collected information with the time stamp, IoT in healthcare enables interoperability, machine-to-machine communication [2], information exchange, and data movement [5][9] that makes healthcare service delivery effective. Security [1]is one of the major challenge in IoT , A person is authenticated by different methods , data transmission and reception must be done with high security[9], several methods are adopted to ensure the security of the system like stenography, data hiding etc [3][7].

Intervention of IoT in health care[1]greatly reduces the number of people visits the hospital and also cut down the cost and improve the utilization of the medical resources effectively

Vast amount of data [9] sent by the sensors and connected devices may over crowd the cloud and that may cause reduction in the performance of the cloud [4][6] , some kind of elimination and reduction of unwanted and redundant data is needed at the intermediate stages

The main goal of this proposed system is to enable those living independently to continue doing so while still providing family and caregivers a peace of mind about their wellbeing [1]. “Has there been no activity in the house for several hours? Has Mom been out of bed for a prolonged period at night?”0

Different kind of sensors are deployed in the living place to monitor the routine of a person continuously [6], Open/close sensors are fixed with the doors to monitor whether the person is there inside the room or not. Presence sensors are placed under the mattresses, seating chairs and even under toilet mats to monitor sleeping activity, sitting time and bathroom usage time, and finally wall deployed activity recognition sensors are used to track general activity levels throughout a day [1][8].

The sensors are all connected to a controller unit which computes the raw data from the sensors [2] and processes them to be useful information those information are sent to the IoT cloud [4][6]and then they are analysed and saved as inferences [9], Those inferences are classified and sent to the family members and care taker in real time.

Proposed System

The idea of this work is to monitor the day to day activities of the elderly persons who would like to lead the independent living by deploying the sensors [4] in their living space, the acquired raw data from the deployed sensors [2] are processed and converted in to inferences those are sent to the IoT cloud for further storage and transmission [8]

Block Diagram

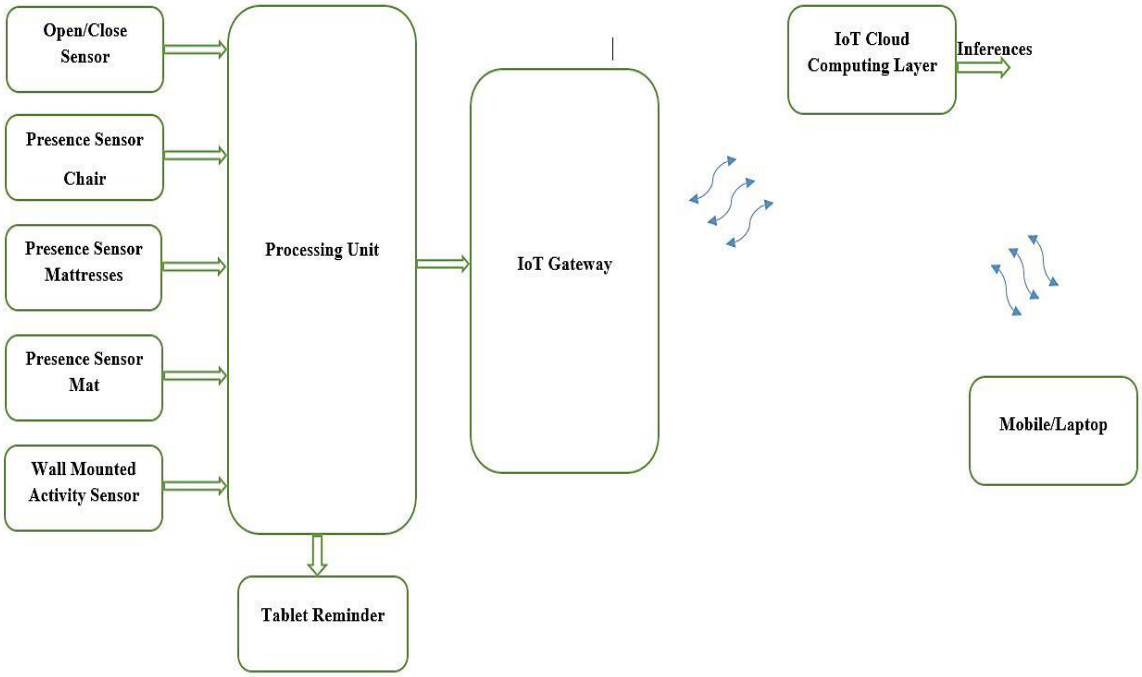

Fig 1. The Overall Block Diagram of the Elderly Care System

In addition this a feature called tablet reminder is included which reminds the individual about the tablets that they need to take in the due time through auditory notifications [1]. Once the raw values [2] are acquired and processed they are sent to the cloud through the IoT gateway, which is basically a computational device with networking capability [6], data redundancy reduction and filtrations [4][9] are done this stage which helps the cloud to be overcrowded and reduces the amount of memory at the cloud significantly.

a) Open Close Sensor Working and Interface

It is fixed beneath the door , it consists of two modules one is Transmitter and another one is receiver , When the door is closed the transmitter and receiver are in contact and intact, when the door is opened the communication interrupted and that leads to a raise of signal , that it turn is connected to the port of the computational unit , Functionality in the controller is written is such a way that whenever the door is opened the timer starts counting and send the timing data to the cloud[10] , the outcome of this module are binary data that tells whether the door is opened or closed , if its opened timer starts counting and send the duration of time in which the door is opened , and the same will be logged in the cloud's data base. If it crosses the threshold limit the same will be intimated to the care taker [4][8].

Flow Diagram for Door Open/ Close

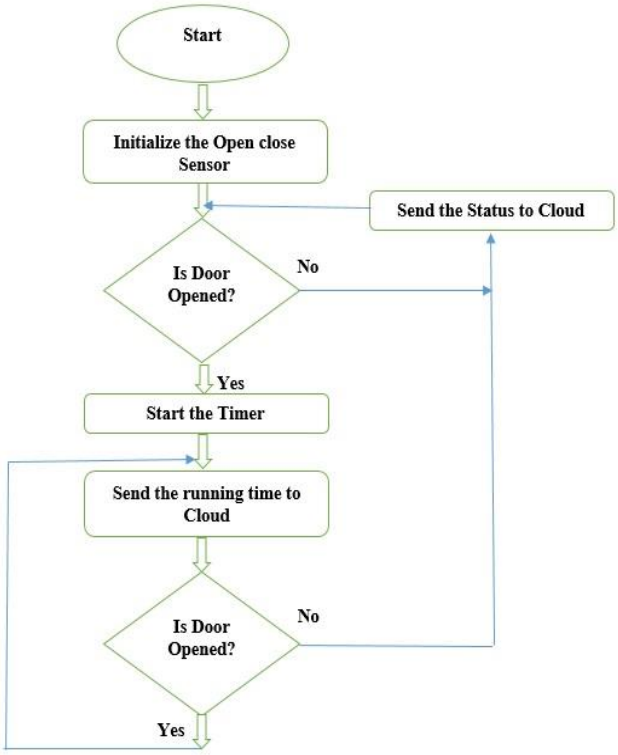

Fig 2. Flow Sequence of Door Open/Close Sensing

Algorithm :

Step1: Initialize the open and close door sensor
Step2: Read the status of the sensor
Step 3:
While (Sensor == opened)
{
Start the Timer and count the timing;
Send the timing values to the cloud;
Repeat until the doors are closed;
}
Reset timer;
Step 4:
else{
send the status of the doors to cloud }
Step 5: Repeat the steps 1 to 4

b) Wall Mounted Activity Sensor

Wall mounted motion sensors[2] are used to track general activity levels throughout a day, Normally it is fixed in the living room in which the person spend most of the time in the day, Ideally it senses the movement of the person very frequently.

If there is no movement or activity for a specific threshold timing, alert will be given immediately to the care taker[10].

Usually the timer would start running under passive condition and reset after encounter the movement in the room where it is fixed[1]. This sensor would help the care taker to know whether all things are normal or any abnormality prevails[8]

Flow Diagram for wall Mounted Activity Recognition sensor

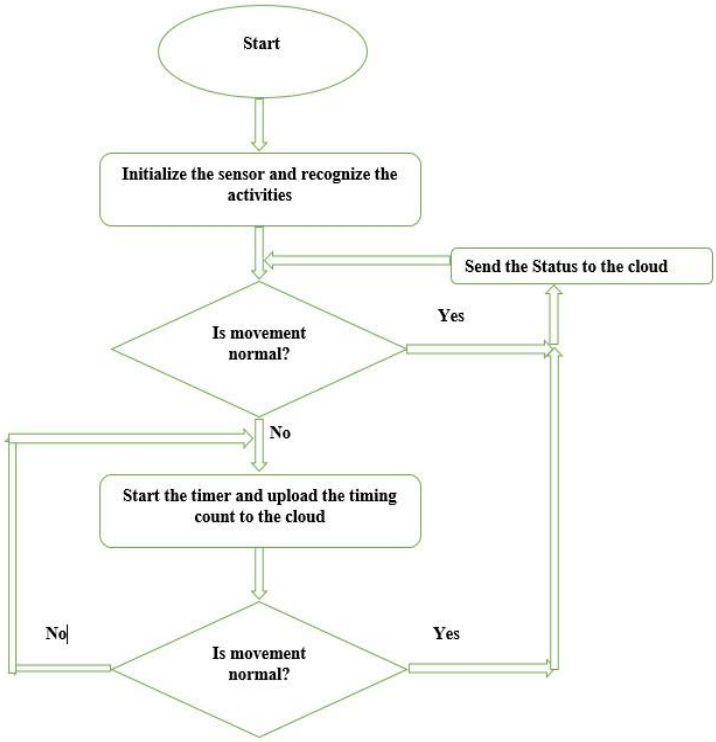

Fig 3. Flow sequence of Activity recognition

Algorithm :

Step1: Initialize the wall mounted activity sensor
Step2: Read the status of the sensor
Step 3:
While (Sensor == passive)
{
Start the Timer and count the timing;
Send the timing values to the cloud;
Repeat until movement detected;
}
Reset timer;
Step 4:
else{
send the status of the sensor to the cloud }
Step 5: Repeat the steps 1 to 4

c) Presence sensor

Presence sensor [2] should be placed under the area which we need to find the presence of a person it gives the binary output i.e. 0 or 1 , when a person is present sensor would output 1 and when it is not it would output 0, in our work the sensor is placed at three different location , mattresses , Toilet mat , Chair.

Since the work is aimed to provide solution for elderly people [1] who would like to live independent living Monitoring there activities [8][10] throughout the day is important , placing the sensor under the mattresses plays a major role in finding the sleeping pattern of

the individual like how many hours the person is sleeping? How comfortable he/she is sleeping? How many times their sleep had been interrupted? By finding all these metric so many indirect inferences can be obtained that will be helpful for doctors to find the sleeping behaviour.

Placing the sensor under the chair helps the care take to draw a conclusion that the elderly person is seating and reading book or having food etc [10].

Presence sensor in the restroom greatly helps the care take to take utmost care by denoting the time the person spent inside the rest room, the average time spent by a person inside the rest room varies from person to person.

Abnormal timing inside the restroom may indicate that the elderly people may faint and fall inside the room, when it is noted and indicated earlier that may save the lives of the elderly people.

Algorithm for Presence sensor

Step 1: Initialize the sensor

Step 2: Read the status of the individual sensors

Step 3: Normalize the reading in order to avoid the false alarm

Step 4: Start the timer and send the timing values to the cloud continuously

Step 5: If everything is normal reset the timer and continue to read the sensor

Step 6: If any of the timing exceeds the threshold value raise a warning signal and alert the care taker

Step 7: Repeat step 1 – 5

d)Tablet Reminder

The care taker has to place the pills inside five different colour of Compact boxes as per the prescription from the doctors , a voice assistance feature remind the elderly people to take the medicine in the due time, a verbal guidance.

It will be given by the system to the elderly to take the medicine correctly , that would tell the no of tablets to be taken from each boxes during morning , noon time and night if needed in between at any time , this is accomplished with the help of the voice play back module (SD card reading and playing) and Real Time Clock.

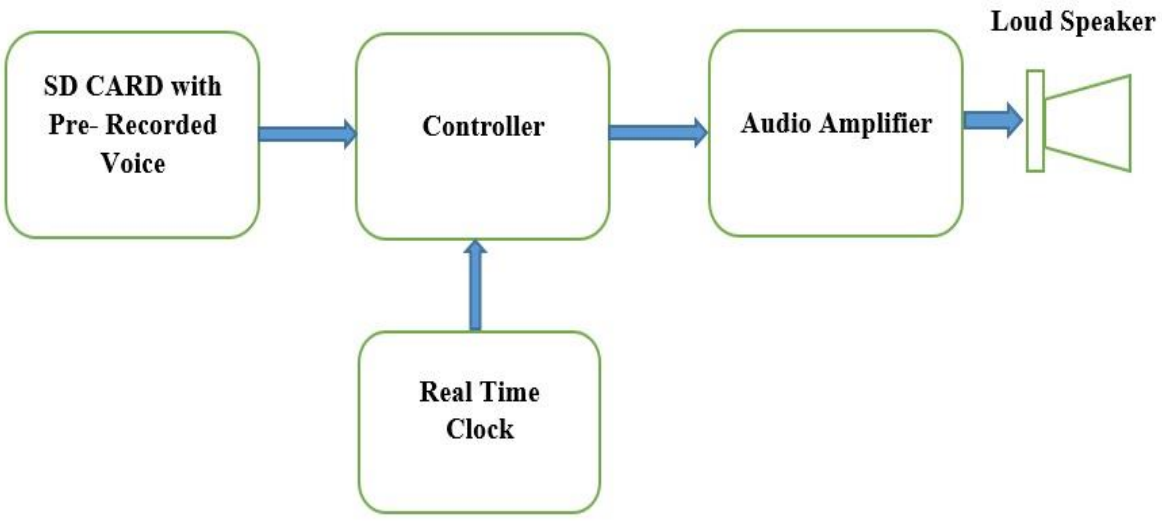

Fig 4. Block Interconnection of Tablet Reminder

Pre-recorded voice with 8 bit resolution , Sampling frequency of 16,000 Hz Audio channel-mono is stored in the SD Card.
And in the predefined timing the corresponding voice note will be enabled and played back reminding the elderly people to take the pills in the due time , the same will be intimated to the care taker.

Overall Inferences

Sensor Type	Nature of the Signal	Activity	Inferences
Door close /Open	Binary with Time Duration	Find the opening and closing of the Door	Elderly might have Forgotten to close the door Possible intruder Entry Elderly not at home
Presence Sensor – Mattresses	Binary with Time Duration	Sleeping Time Duration	Prolonged occupancy Degraded Health Conditions Variation in Sleeping Behaviour
Presence Sensor –Chair	Binary with Time Duration	Sitting /Reading Time	Reading Time Sitting Time
Presence Sensor – Rest Room	Binary with Time Duration	Restroom occupancy time	Sudden conscious loss Drowsiness Possible Fell down
Wall mounted activity Sensor	Binary with Time count	Active /Passive movement Time	Whether People is moving inside the room Drowsiness, Degraded Health Condition s
SD Card	i2c , Analogue	Reminder Voice alert	Reminds the Elderly people to take medicine in due time

Table 1. Sensors and Inferences mapping

Outputs

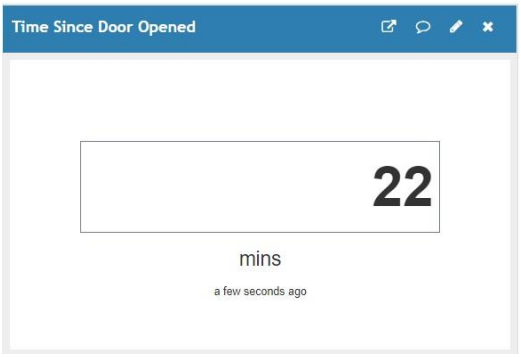

Fig 5. Time count since the door opened

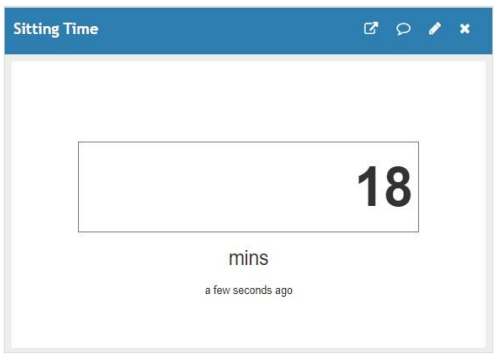

Fig 6. Sitting Time

The above fig shows the time since the door opened and Sitting time on the chair these values are directly taken from the IoT Dashboard .

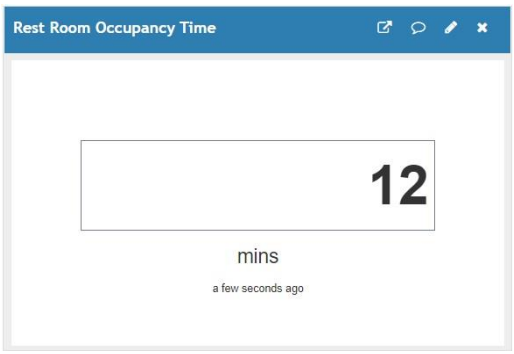

Fig 7. Rest room occupancy Time

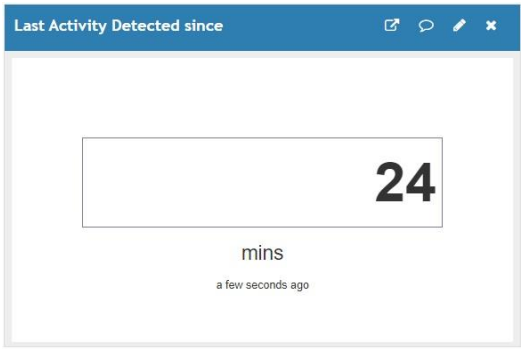

Fig 8. Wall Mounted activity detection Time

The above two outputs shows the restroom occupancy time and the duration in which the living room is passive that is if no movment is detected in the room count will start and upload to iot cloud longer passive time may be considered as abnormal event.

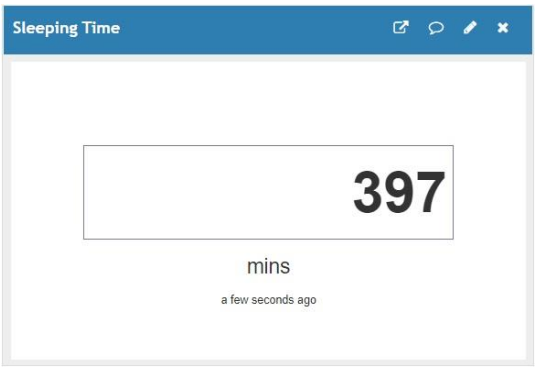

Fig 9. Sleeping Time

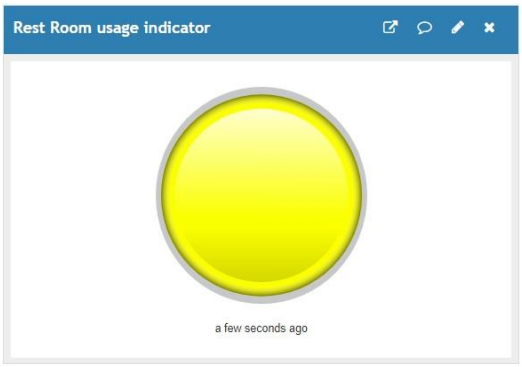

Fig 10. Indicator for restroom usage

The bed occupancy time can be calculated with the help of the sensors placed under the mattresses, several parameters and inferences can be drawn from this sensor like sleeping time sleeping pattern, no of times wake up for restroom water and the level of comfort in sleep after specific medication can be analysed.

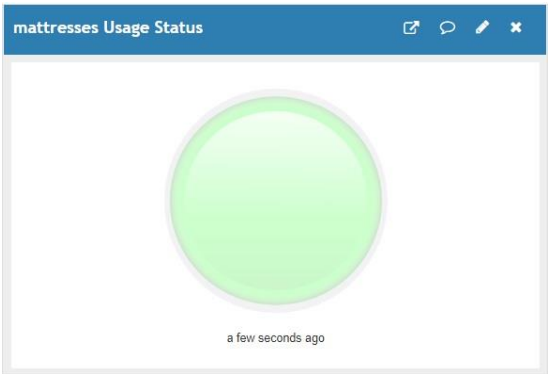

Fig 11. Bed occupancy Indicator

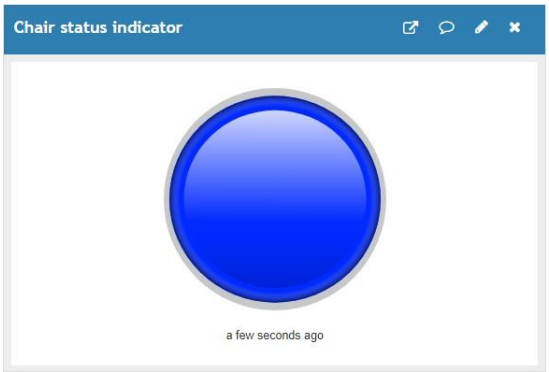

Fig 12. Sitting Indicator

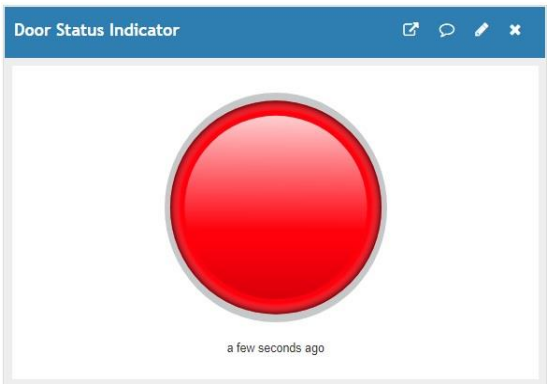

Fig 13. Door open Inidcator

Fig 14. Activity Indicator

When the door is opened the red light glows and if there is normal movement inside the living room green light glows otherwise it is off state and alert the care taker

Conclusion

It is evident that by using all these sensors indiviaully several inferences can be drwan , if all those inferences are connected and analzyed many more such inferences can be obtained.
It will be very much helpful to the individual, doctors and care takers for example the bed occupancy and the rest room occupancy can be connected and the indiviual inferences can be combined and get a new inference like how many times the individual wakes up for water, restroom and for some other reasons , this work will be very much helpful to the eldery especially the parkinsonian , people with neurological disorder and degradartion.

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