IOT Based Remote Livelihood Monitoring For Elderly People Care Assessment

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Abstract - This paper deals with livelihood monitoring and care assessment of old age people based on Internet of things. The usage of electrical and non-electrical home appliances as well as health conditions are monitored by the sensors such as electrical sensor, force sensor, temperature sensor and contact sensor. All sensors are integrated into a common sensor node and sensor data are analyzed to predict wellness parameters. Based on the wellness parameters, the daily activities of elderly people are classified as neither normal nor abnormal. In case of abnormal condition, the automatic alert will be given to nearby hospitals and local care takers for immediate medical assistance. Additionally, the well-being conditions are periodically updated in IoT cloud for real time monitoring. Experiment was conducted and the performance was tested by the prediction of well-being conditions based on usage and non-usage of home appliances. From results, it is inferred that the proposed approach suffices old-age community to lead safe life without fear.

Keywords - IoT, remote livelihood monitoring, sensor-based care assessment, wellness parameter

1. Introduction
In recent days, old age homes are keep on increasing day-by-day and especially, the number of elderly people living alone in home is considerably higher because of non-availability of children to take care. It is quite nature that aging amongst elderly people leads to lack of physical activities and reduce their mental capacity. Older people often forget to take medicine and food at correct time or unfortunately fall into floor which leads to permanent disability or even death. The world health organization also reports that majority of the countries across globe are still facing challenge to take care of elderly health. On the other side, children working abroad are sometimes worrying about their living alone parents and ready to adopt good supportive mechanism for their older parents to monitor daily activities. Many contributions have been reported in recent years to ensure elderly health conditions. Several electronic products and wearable devices are also suggested to spot elderly falls [1-7]. [8] developed a fuzzy model to assess the living patterns of older people round-the-clock. However, the system involves more complexity with only three wireless sensors and it is not sufficient to assess the well-being conditions. [9] proposed a system that employs wearable devices for data collection and several classifiers to identify real time actions. Nevertheless, it does not detect abnormal events including fall or bump. [10] introduced smart monitoring based on knowledge-driven approach. This approach works in three steps such as preparing domain knowledge, activity monitoring and semantic classification. [11] presented an IoT monitoring system for elderly people. In this system, sensors are integrated to monitor sleeping and movement pattern of elderly people. These living patterns are also pushed into IoT cloud for online processing. Conversely, it does not monitor the usage and non-usage of house-hold appliances. That is the abnormal usage of household appliances cannot be predicted. Specifically, this system fails when older sometimes forget to turn OFF any home appliance or it is left as ON beyond the time limit due to ill-health of elderly. To alleviate the aforementioned matters, a new IoT based remote livelihood monitoring is proposed in this article. This system provides well-being assistance for elderly people and takes preventive measures well in advance to avoid the casualty.

2. System Overview
The proposed system process is depicted in Figure 1. It involves three stages of working including data collection, wellness parameter estimation and event classification.

Sensor data collection
The proposed framework does not use any vision based sensors and thus it ensures the privacy of old age people. Moreover, there is a possibility of accepting wearable devices amongst old age people instead of vision cameras. In proposed approach, sensors are fixed with all electrical home appliances as well as non-electrical appliances such as bed, dining chairs and living room chairs to monitor its usage by elderly people. The usage of appliances depends on the elderly activities and including cooking, taking rest, sleeping and grooming. In addition to that, other sensors such as heart rate sensor, pressure sensor and skin sensor are used to continuously monitor the health conditions of old age people. All sensors are assigned with unique ID and specified time slots for daily activity monitoring. For an example, the time slot between 7 PM to 9 PM is labelled as dinner. The central gateway node acts as master unit and it is integrated with sensor nodes of all home appliances as well as biological sensors. This central unit collects the information about the maximum and minimum usage of electrical appliances as well as non-electrical parts such as beds and chairs.
Wellness parameter estimation

Once the sensor data are collected from sensors, the wellness parameters such as wellness based on inactive timeslots of appliances \( P_1 \) and wellness based on excess usage of appliances \( P_2 \) are estimated as in Equations (1) and (2).

\[
P_1 = \frac{1 - I_{\text{inactive}}}{T_{\text{max}}} \quad (1)
\]

\[
P_2 = 1 + \frac{1 - I_{\text{active}}}{T_{\text{usage}}} \quad (2)
\]

where \( I_{\text{inactive}} \) and \( T_{\text{max}} \) are inactive duration of all appliances and maximum inactive duration respectively. In (2), \( I_{\text{active}} \) and \( T_{\text{usage}} \) are active duration of any appliance and maximum normal usage duration, respectively.

Event classification

In event classification stage, the sensors status are predicted based on the wellness parameters and the decision about normal and abnormal event classification is done based the sensor status as in Equation (3). In addition to that, all information including heartbeat rate, body temperature and pressure are uploaded into the IoT cloud server simultaneously for real time monitoring the sensor data are collected from sensors, the wellness parameters such as wellness based on inactive timeslots of appliances [12-14].

\[
\text{Activity} = \begin{cases} 
  P_1 = 1 & P_2 = 1 ; \text{ Normal} \\
  P_1 < 0.5 & P_2 < 0.8 ; \text{ Abnormal}
\end{cases} \quad (3)
\]

From (3), it is inferred that the daily activity is classified as normal when both wellness parameters are equal to 1 and it is classified as abnormal if \( P_1 \) is less than 0.5 and \( P_2 \) is less than 0.8. Whenever, the abnormal activity is predicted, the message alert will be sent to the concerned as well as nearest hospital for immediate medical assistance.

3. Experimental Results

The experiment was conducted on different locations to measure the system efficiency and demonstrated successfully using ProTeus software in PIC microcontroller environment. Figure 2(a)-2(e) deliberate the hardware setup and working of proposed approach. The design of proposed approach is simulated and tested and using ProTeus software. Figures 3-5 show the simulation results of the proposed system used for monitoring daily activities of elderly people and sending the message alert through IoT in case of emergency.
d) current sensor for electric appliances

e) hear rate sensor.

The current sensor continuously senses the current rating of electrical appliances operated by the elder people. The sensed data is compared with the predefined value in the microcontroller and if it exceeds the threshold limit, the buzzer starts alarming and the message will be sent to the nearest hospital for immediate rescue operation.

Fig 3 shows the experimental results under the high current condition. In proposed system, the current rating of 5 A is set as the threshold limit. The LCD also displays which sensor data is in abnormal condition. Fig. 4 shows the experimental results under the flex detection. The flex sensor senses the force exerted by the elder people under various conditions such as sleeping, sitting etc. If it exceeds the threshold value (preset value used 45), the buzzer starts alarming and an emergency message will be sent.

Fig 5 shows the experimental results under the high temperature condition. The temperature sensor senses the temperature of the electrical appliances operated by the elder people. The sensed data is compared with the predefined value, the buzzer starts alarming and the message will be sent to the nearest hospital for immediate rescue operation.
Fig. 6: Experimental results under high pulse detection

Figure 6 shows the experimental results under the high pulse detection. The heartbeat sensor senses the pulse of the elderly people under various conditions. If it exceeds the threshold value (i.e., 120 pulse/min), the buzzer starts alarming and an emergency message will be sent through GSM module.

4. Conclusion
An IoT based remote livelihood monitoring of elderly people is presented in this article. In this proposed system, sensors are fixed at home appliances and sensor data are collected and analyzed in terms of wellness parameters. These parameters are used to identify the abnormality of daily activities done by the elderly people. If any abnormal event is identified, then message alert will be sent to the nearby hospital as well as relatives for immediate medical assistance. The well-being conditions are also updated regularly to the IoT cloud server for remote monitoring. The proposed approach is successfully implemented in ProTeus software environment and prototype is developed for performance evaluation. Experiment results indicate that this system is well suitable for remote care assessment of elderly people when compared to existing system.

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