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Medical Sensor Network Based Real Time Activity and Healthcare Monitoring for Mute and Paralytic Persons

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ABSTRACT: The worldwide elderly population is 13% and may rise to 16.4% by 2030 due to the modern medical facility available and encouraging green environment. The advancements in Wireless Sensor Networking (WSN) provide enormous opportunities in healthcare systems. WSN based Remote Healthcare Monitoring System (RHMS) now proposed for elderly people provides flexibility to be at their comfortable home and not being at the hospital. The remote real time monitoring activity and physiological parameters of elderly people suffering from various chronic diseases help to make accurate diagnosis for better treatment. Earlier glove based Sign to Speech (STS) system for mute people were designed to generate synthesized Speech Signal to adopt for English, Kannada and different Indian languages and to expand the services provided to the people in need of mobility assistance a Sensor Controlled Wheelchair (SCW) was developed, which establishes Ad-hoc Sensor Networks to medically challenged old age mute and paralytic patients to lead peacefully satisfying life.

KEY WORDS: Remote Healthcare Monitoring System, Sensor Controlled Wheelchair, Sign to Speech System, Wireless Sensor Networking.

I.INTRODUCTION

Gesture is the effective way of communication for the people having speech disorder and it exists in all means of communication among humans during their discussions [1]. However, the sign recognition based methods can be primarily distributed into Vision and Glove based Approaches. The vision based system fails during no visible light and it includes challenges in image and video processing in varying lighting conditions, backgrounds, field of scan constraints and occlusion. The STS system adopted glove based technique provides larger quality and it will efficiently translate each gesture in to speech. Thus it can be used for the speechless patients not able to speak but are able to move their fingers and hand.

Wheelchair based system enables the elder people to move around without any tussle to fulfil their daily needs [1]. The traditional wheelchairs are not user friendly and do not provide any safety to the user. Thus SCW was designed as traditional and automatic wheelchairs are not having any sensors to control the movement of wheelchair in case of emergency.

WSNs are essential in domains such as industrial operations, healthcare, environmental, infrastructure and military applications provides adoptive visions in various domains. The flexibility provided in WSNs overcomes number of wires to be connected to various devices in the hospitals [3] [4]. WSN is made up of a base station and several sensor nodes possible to acquire health parameters of elderly persons and necessary treatment can be given the patient as required, Fig., 1.

In worldwide nearly 32% of elder people death is cause of cardiovascular illnesses, due to imperfection of heart and blood vessels. The real time monitoring of these diseases is needful, which requires the patient to be shifted to hospital leads to increased cost and patients cannot live their life peacefully and independently [5] [6]. Thus, RHMS is designed.

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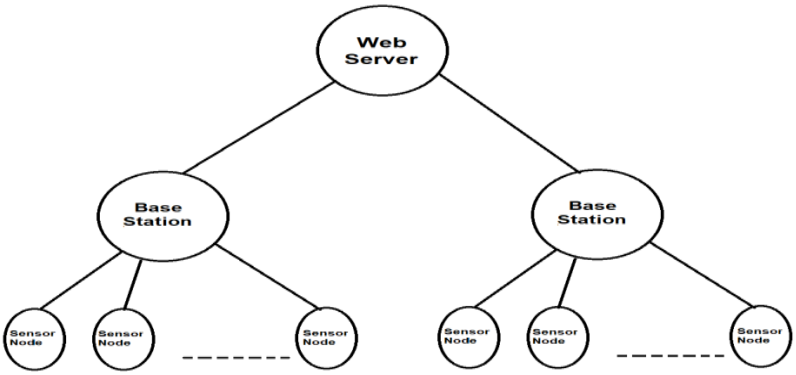

Structure of WSN [7]

The proposed work is the extended work of "Design and Development of Medical Sensor Network for Differently Abled Persons" carried out by the same authors.

II. SIGNIFICANCE OF THE SYSTEM

The paper mainly focuses on development of Medical Sensor Network for Mute and Paralytic Persons. The study of literature survey is presented in section III, Methodology is explained in section IV, section V covers the experimental results of the study and section VI discusses the future study and Conclusion.

III. LITERATURE SURVEY

Narendra Kumar G. et al., [1] has prescribed Design and Development of Medical Sensor Network for Differently Abled Persons in which Sign to Speech system (STS) and Sensor controlled Wheelchair (SCW) has been designed.

Joseph Y. Lucisano. et al., [2] has developed Glucose Monitoring With Diabetes Using a Extended Tenure Embedded Sensor Model. The sensors in the system are depends on a membrane having immobilized glucose oxidase and catalase coupled to oxygen electrodes and a telemetry system, combined as an implant.

Ashraf Darwish. et al., [3] described the purpose of Wireless Sensor Network Solutions for Healthcare Monitoring provides advances and upcoming trend of study on wearable and implantable body area network for endless observing of patients.

Mohammed Al-khafajiy. et al., [5] has invented remote health monitoring of elderly through wearable sensors. The distant real time monitoring of health identifies relapses in conditions and thus, allowing prompt involvement.

George VasilevAngelov. et al., [6] Demonstrated Remote healthcare monitoring, which is based on non-invasive and wearable sensors, actuators and recent information technologies proposals well organized solutions that permits people to live in their relaxed environment.

IV. METHODOLOGY

The proposed Medical Sensor Network based system, Fig., 2includes healthcare system to monitor activity and physiological parameters of elderly people suffering from various chronic diseases help to make accurate diagnosis for better treatment. It provides elder people to move around without any tussle to fulfil their daily needs and enables communication for the person having speech disorder.

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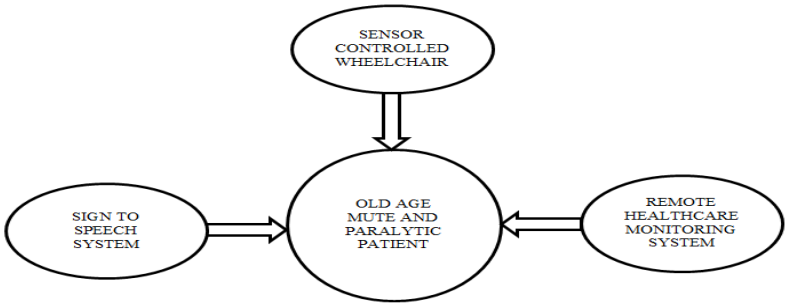
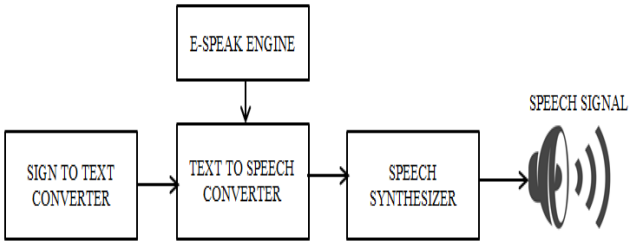


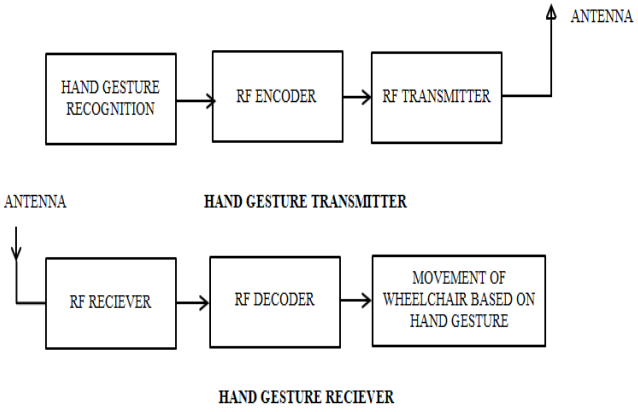
Architecture of Proposed Medical Sensor Network

The human fingers are able to interpret different gestures, Flex Sensor and MPU6050 based finger and hand gesture is best suited to convert Sign Language into Text as it is more reliable and cost effective solution. However, TTS based E-Speak is used to convert obtained text into speech signal and further, obtained speech signal is synthesized to adopt for English, Kannada or any predefined different Indian language, Fig., 3.



Block Diagram of STS System.

The movement of SCW is depends on hand gesture of the user and is designed by using MPU6050 based accelerometer. The hand gesture is transmitted through 434MHz RF transceiver to operate and move SCW in different directions. The Ultrasonic Sensors have been included to stop the wheelchair during obstacle detection and provide safety to elder person, Fig., 4.



Block diagram of SCW.

The Remote Healthcare Monitoring System, Fig., 5 has wearable and implantable sensors are placed on the body of old age patients for monitoring physiological signals, Moisture, Heartbeat, Temperature, Glucose Level, Accelerometer, Eye Blink. It is then observed by the doctors and takes necessary precautions and henceforth treatment as required.

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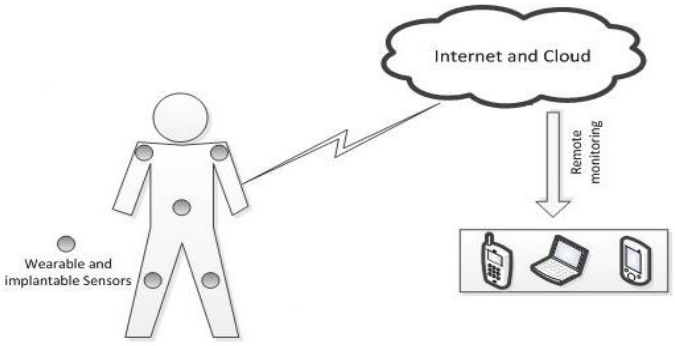
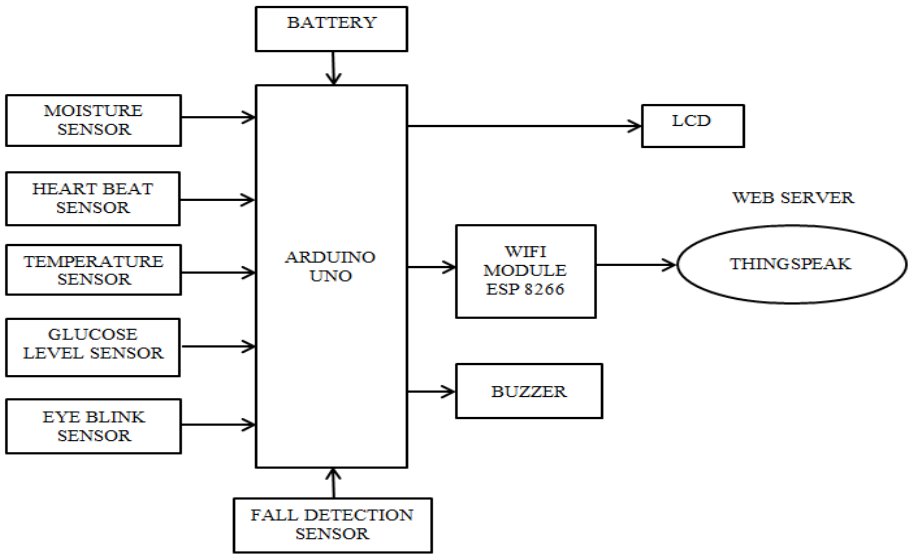


Remote Healthcare Monitoring System

The block diagram of WSN based Remote Healthcare Monitoring System, Fig., 6. The Sensor Node collecting real time healthcare parameters Moisture, Heartbeat, Temperature, Glucose Level, Accelerometer, Eye Blink of a patient and transmitted to the Base Station through WIFI interface. The sensor parameters collected from each patient is separately analysed on Web Server and necessary actions will be taken by the doctors to safeguard the life of the patient.



Block diagram of RHMS.

A) Fall Detection Sensor and Temperature Sensor

Fall Detection and Temperature Sensor Module MPU6050 is particularly human activity recognition technologies based on wearable sensors with on-chip Temperature Sensor can be used for fall detection and body temperature of elderly person.

B) Eye Blink Sensor

The eye closing and opening makes variations in the reflected rays. The reflected rays from the eye are received by Infrared Rays (IR) receiver. The Eye Blink Sensor is used to find the elderly person is awake or sleeping.

C) Moisture Sensor

The Moisture Sensor is a self-designed sensor, which detects the sweating of a patient and informs the caretaker via the buzzer and displays the condition of the patient on the LCD. Thus, the patient could be helped out at the earliest to reduce the risk of infection and cold.

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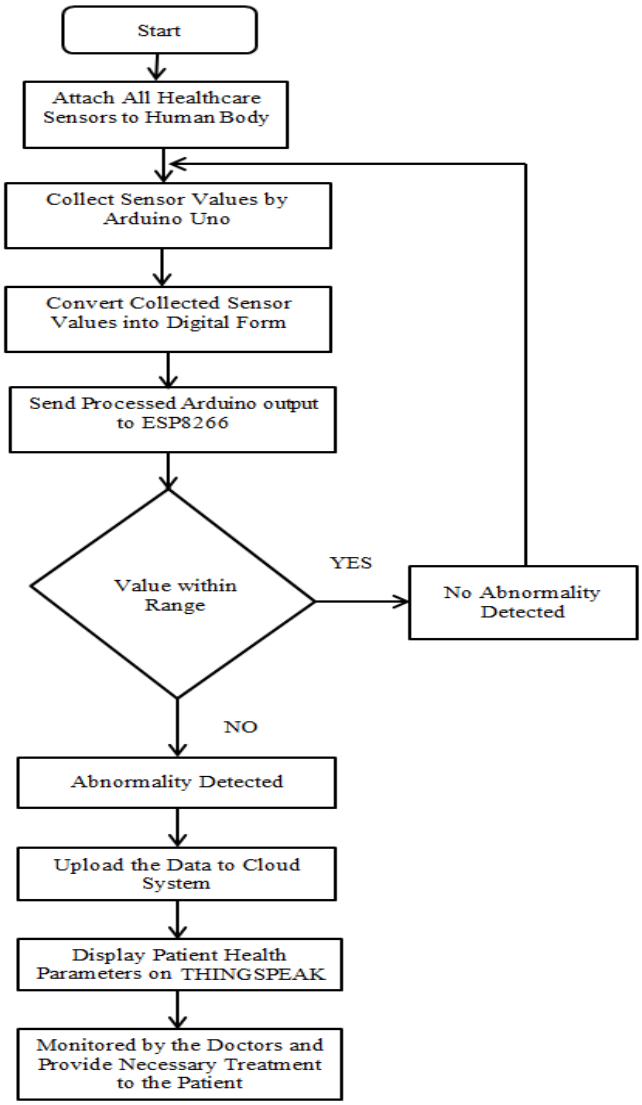
D) Heart Rate Sensor

Photo Plethysmography principle is used in A0813Heartbeat Sensor. The variations in blood volume in any organ of the body outcomes in varying light intensity through the vascular organ. Thus, blood volume flow rate is calculated from the rate of heart beat pulses. Heartbeat Sensor containing photodiode and infrared LED for detecting pulses of finger. The photodiode and infrared LED are located side by side. As tissue is illuminated by the light, photodiode captures the reproduced rays.



Flowchart of RHMS.

The working principle of the established RHMS is presented in flowchart, Fig., 7. The system provides eminence healthcare facility for the elder people to live independently at their home using Medical Sensor Networks (MSNs). The common issues in acquiring physical facts from patients for diagnosis, monitoring and treatment are addressed using MSNs.

V. EXPERIMENTAL RESULTS

Implementation has shown good results in encouraging the patients during recovery transition.

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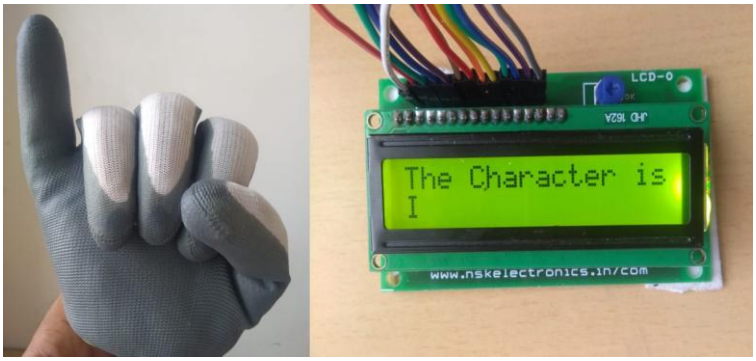
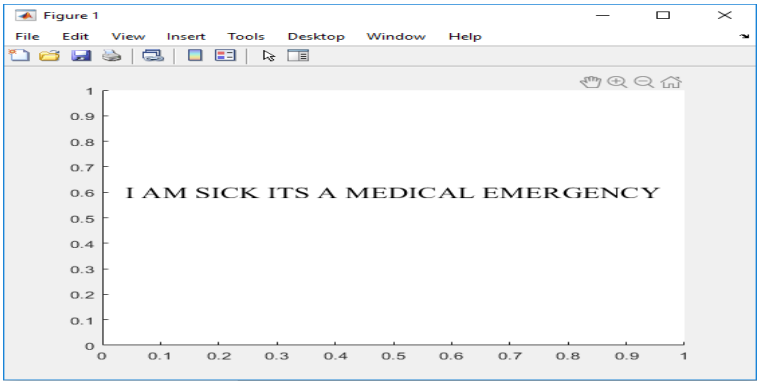


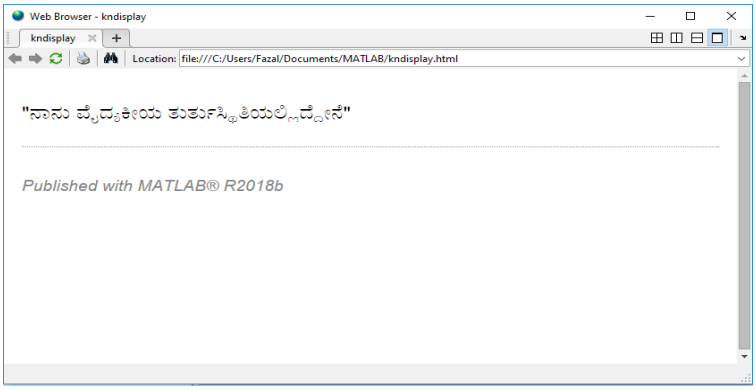
Sign for English Alphabet 'I'

Sign for English Alphabet 'I' based on ASL, Fig., 8 converted into corresponding text on the right hand side by processing the obtained values of Flex Sensor and MPU6050 Sensors.



Combination Many of Signs to Speech Conversion in English Language

Based on the combination of many ASL words and letters, obtained text is synthesized in MATLAB using Speech API of Windows OS to generate Speech Signal in English language, Fig., 9.



Combination of Many Signs to Speech Conversion in Kannada Language

Based on the combination of many ASL words and letters, obtained text in English language is converted in to Kannada language using Google API and then synthesized using E-Speak to generate Speech Signal in Kannada language, Fig., 10.

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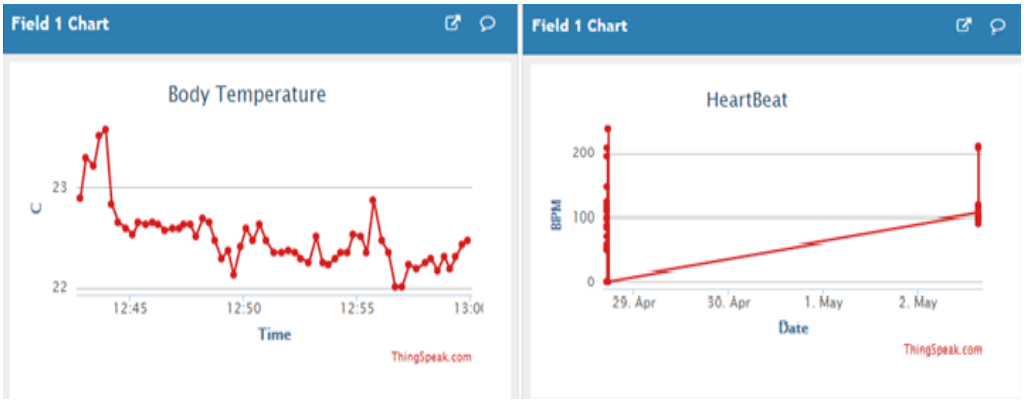
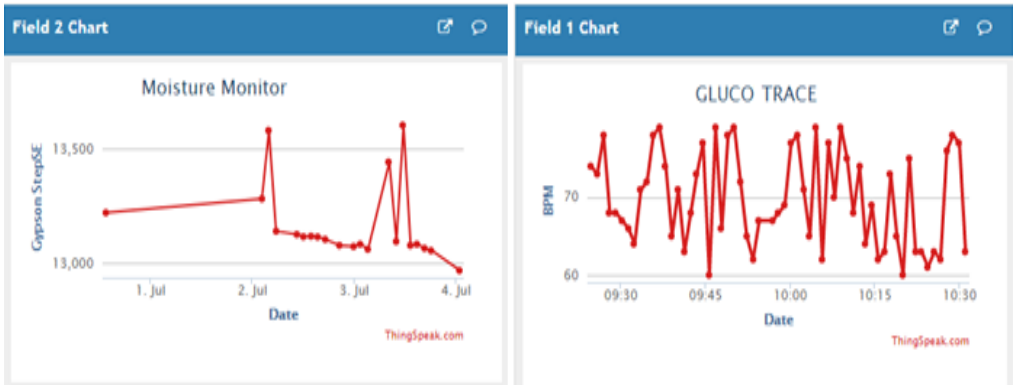
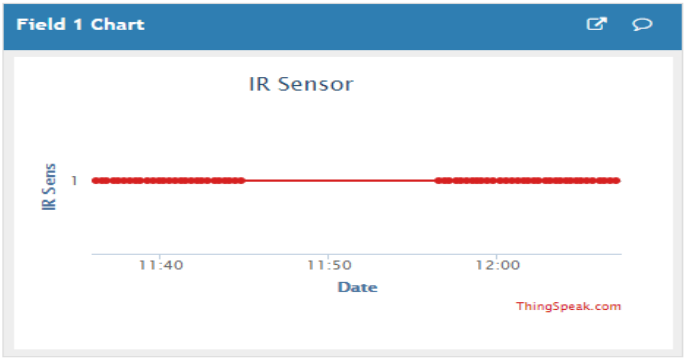


Response of the Body Temperature and Heart Beat on ThingSpeak



Response of the Body Moisture andGlucose on ThingSpeak



Response of the Eye Blink on ThingSpeak

VI.CONCLUSION AND FUTURE WORK

The system adopted to provide Speech Signal in English, Kannada and other required Indian languages for mute patient to speak for their needs by expressing their gestures useful to fill the communication gap between patients, doctors and relatives. The old age and paralytic patients are provided with Remote Healthcare monitoring to stay at their comfortable home instead being in expensive healthcare facilities and Sensor Controlled Wheelchair for mobility

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impaired elder people with automatic obstacle detection to move through indoor and outdoor environments. The STS, SCW and RHMS nodes establishing Ad-hoc Medical Sensor Networks to medically challenged old age mute and paralytic patients to lead peaceful and satisfying life.

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