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Efficient Thought-Controlled Automation System for Differently Abled Persons

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Abstract—*The proposed Home Automation system is designed for the development of wearable technology for medical purposes and lifestyle applications. It focuses on controlling the home appliances by the mere use of our Thoughts. The current ordinary wall switches are located at different parts of a house and thus obligates manual operations. This is sometimes a point of difficulty or discomfort for elderly and differently abled people. The available options in the market like IOT based, voice recognition and GSM based home automation systems have the drawbacks of internet availability, noise interference and the requirement for manual effort respectively. This creates a provision for a more efficient system. The work proposed in this paper suggests a low cost thought controlled home automation system devised using TGAM off-shelf digital signal processing module. The entire system is designed using various sensors and already available microcontroller based platforms. The key idea is to identify the spatial coordinates of various appliances that need to be controlled and execute an ON/OFF turning pulse obtained by measuring alpha and beta waves from human brain falling in EEG power spectrum.*

Keywords:- *TGM, BCI, EEG*

1. INTRODUCTION:

Brain computer interface (BCI) is a methodology with the help of which users can communicate with the external devices [1].In the non-invasive BCI approach the electrodes are directly placed on the scalp [2] and the captured brain waves are used for controlling various home appliances. The BCI based home automation technology is simple and also reduces the manual efforts. It can bring a revolutionary change in our lives [1]. We are proposing a "Thought Controlled Home Automation System"as an application of BCI where we can control different home devices with the help of brain waves [1]. Also we are taking the accelerometer values along with the brain waves which enables regulating of different home appliances located at different coordinates. These two values are transmitted through nRFtransmitter. On the receiver side, the processor processes these values and accordingly switches a particular device

2. BACKGROUND:

The 'Home Automation' concept is not new; it has existed for many years. The idea of Home Automation System was introduced to make life easier[3]. It makes the appliances at home more convenient and energy saving. As the technology is becoming more affordable, the concept of Home Automation System concept has been revolutionised from wired technology to the current advanced wireless technologies like Bluetooth, GSM, Speech recognition, IOT, Hand Gestures etc., for achieving remote operations. These systems have their own specific advantages and applications such as high speed, low power consumption, low cost [4]. Despite of having dominance over each other, these systems lack in many areas like low data rate, noise interference, continuous internet availability and unreliability [4], [5] leaving a provision for more research in the field of home automation system which is more efficient and user friendly. Thought Controlled Home Automation is the new research in this field which not only overcomes these drawbacks but also presents a more convenient and feasible system. The thought control home automation system presents a design and implementation of automation system that can be controlled by using the attention values and coordinates of the head. As the system controls the home appliances merely by thoughts and least manual effort is required, it makes the system more suitable for elderly and differently able people who cannot move their body for basic operations.

Table 1: Comparison of different types of home automation systems [5]

System	Cost	Speed	Range	Primary Communication
Bluetooth	Low	Low	Low	Bluetooth
Voice recognition	Low	High	Medium	Voice commands
GSM	High	Slow	High	Text messages
IOT	High	Slow	High	Internet
Gesture	Low	High	Low	Gestures

3. METHODOLOGY:

The thought controlled home automation system proposedin this paper works in two broad sections; one with the TGAM module and another with the accelerometer, the values from both are transmitted using Bluetooth and NRF modules programmed by different algorithms respectively. These are received and processed by the microcontroller that triggers the switching circuit to control the specified appliance

A. Acquisition of Attention values by TGAM

Brainwave sensor acts as a brain computer interface (BCI) that is used to capture electrical signals produced by the neurons of our brain. Any slight increment and decrement in the Beta signals, which are produced by the simultaneous change in the concentration of the user, is captured and transmitted using Bluetooth technology. The Bluetooth module wirelessly transmits the data to the processing module. The processing module is fed with algorithms to measure the changes and store the data for comparisons needed for operating the appliances.

B. *Measurement of head movements by the accelerometer*.

Accelerometer senses the dynamic acceleration of a body. In this project the accelerometer measures the head movements of the user in x, y and z coordinates, for precise manipulation of appliances placed at different positions in a room. The accelerometer converts the head movements of the user into voltages and feeds them to the processing module 1 shown in the figure A. The processing module 1 sends the data to the nRF which is a single chip radio trans-receiver with an external duck antenna that increases the range of transmission. Another nRF placed on the receiver end directs the data to the processing module 2, which is the main processor of the system. The output of the accelerometer and the TGAM module are fed into the processing module 1.

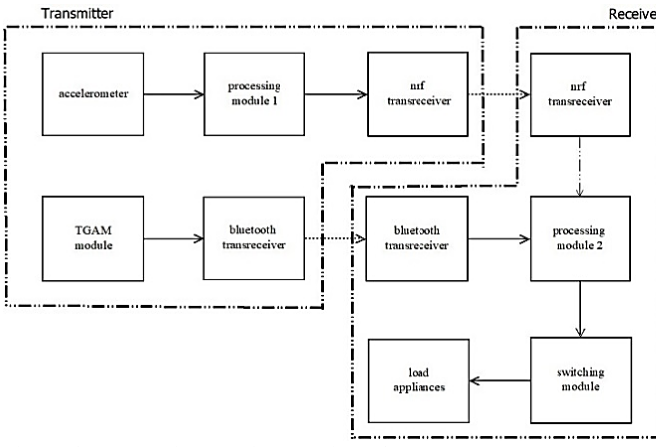

Figure 2: Block diagram illustration of the proposed Thought-Controlled Automation System

The data from the TGAM module is compared to the predefined threshold value that decides whether a device would be turned ON or OFF. Concurrently the values from the accelerometer are processed. With the distinct values of attention and accelerometer, a specific mechanical switch is triggered that controls the specified appliance.

Table 2: Accelerometer Configuration

Accelerometer Values	Direction	Loads controlled
a<c<b	Straight	Load 1
b<c<d	Diagonal	Load 2
d<c<e	Up	Load 3

a=108; b=99; d=92; e=85

4. RESULT AND ANALYSIS:

The main focus of this project is to design a system which is more efficient and adaptable than other already existing home automation systems. After successfully acquiring the signals from TGAM and Accelerometer, the signals are sent to main processor which processes, compares, and implements the already programmed algorithms to control various home appliances remotely. The whole process of detecting the signals and controlling appliances is characterised by certain parameters like power consumption, reliability, complexity, comfort and range.

i). Power consumption: since the system is designed and implemented after a proper planning and proper installation, it ensures less power consumption making this system more power efficient.

ii). Reliability: This suggested system is 80-100 percent reliable.

iii). Complexity: The proposed system is less complex in terms of its circuitry.

iv). Comfort: since the system is easy to use, least manual effort is required it becomes more comfortable to use this system.

v). Range: its range is 1Km for direct sight of communication and almost 10m for obstructed line of sight.

vi). Flexibility: with the use of accelerometer the user can control appliances positioned at different lines of sight.

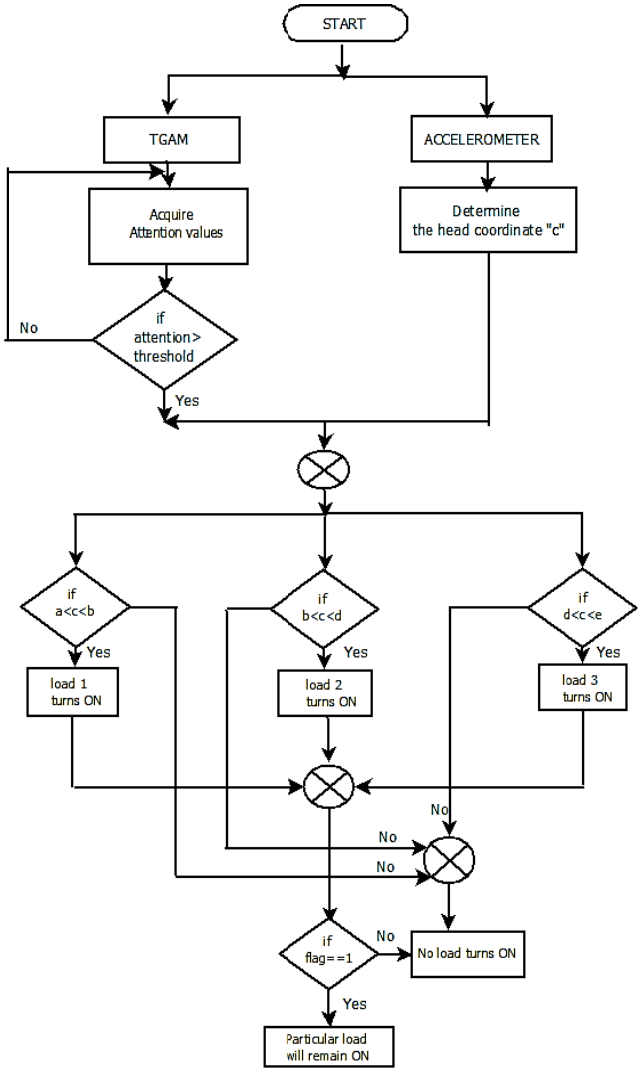

Figure 3: Flow chart Illustration of complete system

vii). Feasibility: this system reduces manual operation.

Table 3: Theoretical calculation of power consumption of the system

Module	Power Consumption	
Nrf 24L01	Transmitter side: 0.24W	Receiver side: 1.37W
Bluetooth	Transmitter side: 0.316W	Receiver side: 0.187W

Total power consumption = 2.073 W.

5. CONCLUSION AND FUTURE WORK:

In this paper, a more desirable of Home Automation System is proposed that overcomes the drawbacks of the current available home automation systems. The suggested Thought Controlled Home Automation system works on least manual effort that makes it suitable for differently abled people. It has comparatively low power consumption, low cost and does not require internet access for functioning. With the use of nRF, it can cover a range of 1 km without having to access the internet and the use of accelerometer increases the reliability and control over the appliances. Furthermore, this system finds its application in Thought Controlled Wheelchairs and Prosthetic Limbs with greater direction control and mobility.

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