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Implement a Circuit System for Brain Wave Application in Power Switch Controlled Circuit

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***Abstract*—Since there are more and more people with increasing age in today's society, seniors' lifestyle has been becoming more and more important, especially those with particular physical disabilities. Moreover, urbanization causing narrowing space prevents elderly and those with physical disabilities to use plugs at the corner of any certain environment. In order to effectively solve this problem, we combine RF wireless transferring system and physiological signals from brain wave induced by vision potential to edit a remote controller at their disposal. This implementation not only helps seniors and physio disabilities to control domestic electric appliances but also environmental friendly. The power usage comparison in the following context proves this application is actually power efficient.**

***Index Terms*—brain wave, power switch, physical disabilities, RF, physiological signal.**

I. Introduction

Brain wave is composed of various signals from differing stimuli. All basic measurements refer from IFCN (International Federation of Clinical Neurophysiology standard [1]). Among them, P300 Visual Evoked Potential, VEP recorded in several studies which include its' clinical measurements and the ways of interpretation is implemented in combination of our creativity and apply in our research[3][4][5][6]. In the reference, VEP involve one interpretation method called Oddball Paradigm[7].

The most discussed issue, reducing carbon, is one of the most important environment- friendly issue. Reducing unnecessary resource use plays pivotal role in it. Increasing numbers of people and dwelling space squeezed raises obstacle to use a plug in a corner. In order to solve this problem, help people with physical incompetence, and, additionally, relieve our green-house effect, we use VEP to control our electrical plugs without mechanical way plugging by hands.

II. System Architecture

This study uses VEP inducing wave by through three points, a detecting point, a reference point and a DRL point, to process this brain wave measurement. This study uses system developing motherboard, ARM7 [11] controlled 16 unit ADC, Digital filtered wave, and algorithm identification to control multiple plugs electricity supply or cut off by RF wireless transferring.

As Figure 1 indicates, all system is divided to hardware and software design. Hardware part is additionally divided into front detection electricity and receiving backend. Software consists of P300 VEP and a user/system interface.

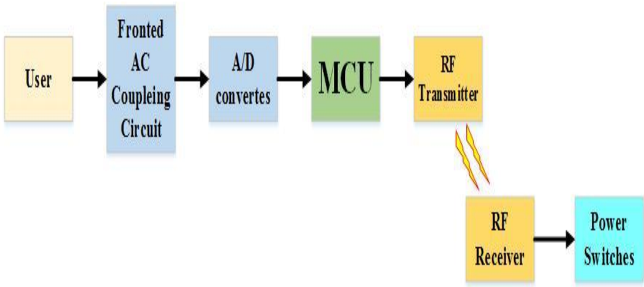

Figure 1: System architecture

III. Design Theorem

In order to achieve the above described functions, all the hardware, firmware, and software are important. The following are the design content of each

A. Hardware

1) Fronted Measurement Circuit

The frontend of this system is detection electricity, which refers the amplifier and DRL circuit from the electricity of ECG[8], and the high and lower channel cutting frequency nevertheless refer IFNC part criteria. Electrical circuit uses scale amplifier DRL circuit to minimize common mode signal between environment and electrode of user, which uses high and low channel circuit retrieving primary segment from brain wave; this is a more efficient and simple way to minimize this hazard. This system uses signal power system; the edition of which requires DRL circuit offer a Vcc/2 reference electrical potential to the user.

2) RF Controlled Circuit

As indicated in the figure 2(a) and (b), system would sent the identifying and analyzing result to HT12-D and RF model. The HT12E, HT12D includes four information lines and eight address lines in order to control 1024 switches.

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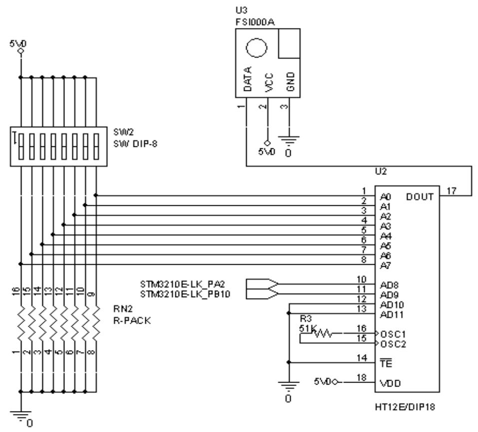

Figure 2(a): RF transmitter

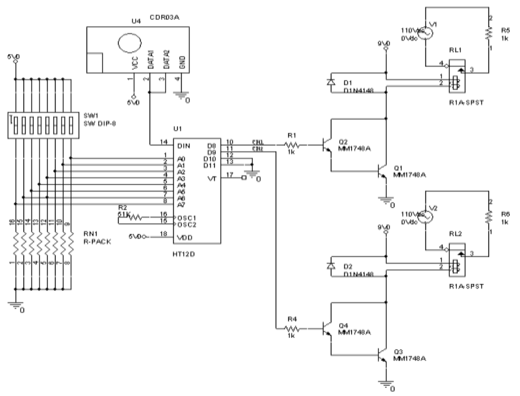

Figure 2(b): RF control circuit

B. Firmware and Software

Transformed by through ARM to ADC, signals from frontend circuit are identified by P300 VEP and analyzed by the wave processing part, which grabs several measured visual movement inducing waves and calculation part in P300. Identify the range between two amplitudes in the electrical potential domain as VEP forming wave. As figure 3 showing, transferred analog-digit after modifying to accurate zero point processes through 2-7Hz filter to form a formatted data, and then calculates as absolute value and by averaging 140 points moment. This outputting results wave would reuse counting algorithm to calculate if the value is in the limit of P300. If the wave goes over eye-movement limit, the value would be rejected. Computer will automatically counts how many the winking sites are and how long each staring site last and compares with each other. Finally, choose the one which is the most and last longest as an indication to control power switch.

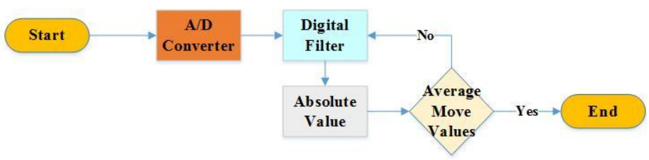

Figure 3: Implement processes

Original signal by through 2 to 6Hz band pass filter outputting wave which would be taken as absolute value and smoothed as showing in figure 4. The black and red arrows point as winking signal and P300 waveform respectively. The black and red dotted lines indicate the range of limitation.

Figure 4: Measurement signal

C. User Interface

In order to induce P300 VEP, this program adopted randomly flash way. The figure 5 consisting of three parts shows how the program process VEP producing brain wave from the user.

1) Preparation time: in order to avoid user' s body movement which could results a deviation of eye movement, this program sets 3 seconds as Ready time for the user to choose function.

2) First Flash tine: after offering a random number and choosing the priority among left-right flashes, processes evoked stimulus.

3) Second Flash time: the sites of flash upside down of first flash time to stimulate

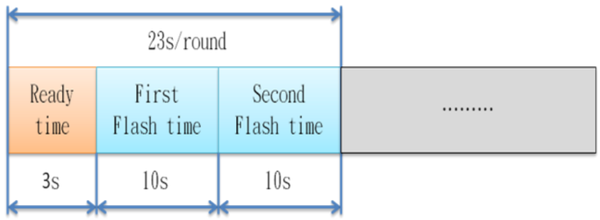

Figure 5: Programing processes

Identifying the flash period of this user/system interface is 23 seconds per round, which, taking P300 as the trigger and going through digital filter, presents at a respecting flash-time point. Figure 6 showing calculated through algorithm is therefore able to control and use.

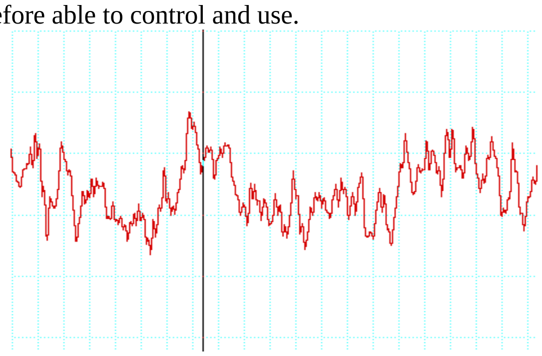

Figure 6: P300 VEP signal

IV. Implement Result.

The oddball paradigm is a new way to stimulate. This randomly mixes two different colors or uses different frequency flashes to alternatively stimulate; which require user counts one color among them. While user is staring and counting, the evoked waves are thus recorded. The stimulated waves are similar and the signal of maximum potential change would be measured as difference between signals.

The only hazard is from environmental factor. In order to avoid environmental factor, the way of randomly green grid appearance is more significant. System measurement flow is in Figure 7.

In the beginning of program, there is 3 second ready or preparation time in order to let user stare on the grid as he wishes. Among those grids, one of them would flash and alternate between black and white colors in 2Hz-frequency for 10 seconds. In process, randomly appears green color effect. After whole the process, another grid would flash as the same way in order to stimulate P300 VEP.

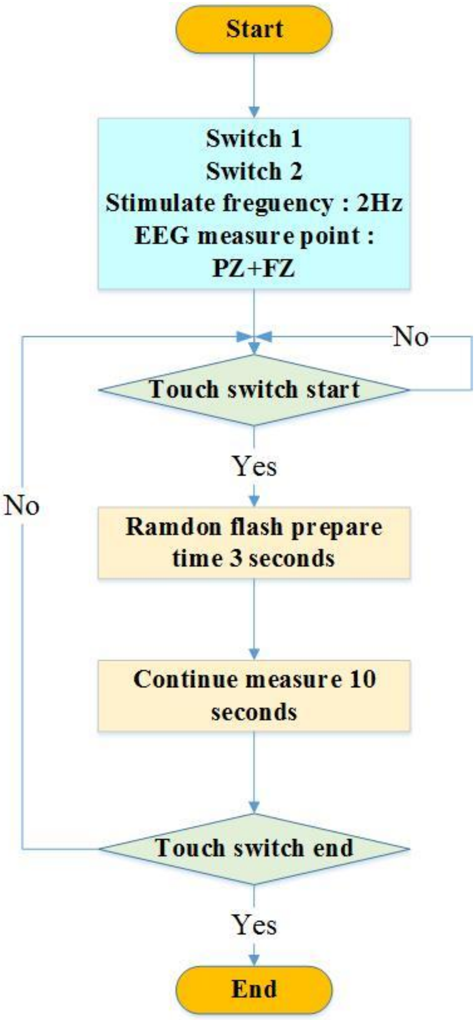

Figure 7: Measure system processes

V. Conclusions

This research referring ARM single-chip developing algorithm and then implement a system which uses P300 VEP to control and apply on the power plug. Only by through P300 VEP interface do he stare at as-wished choice, user can therefore control multiple plugs. This study reserves various pull or plug-in activities and comes to electricity resource preservation and thus saves power. This furthermore helps physical incompetence break space limitation to control power switches.

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