Eeg Based Automatically Triggered Portable Women Safety Device Against Social Crime

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Abstract — Support needed by any individual human for tackling external attack can be effectively fostered by electronic intervention. Deployment of Taser as a protective device for safety of women from sexual assaults and molestation has been formulated. The protective device Taser will be fully automated, triggered by brainwaves of the user. The system proposed has an inherent advantage of minimizing delay between psychological realization and physical reaction. System continuously monitors the characteristics of brainwaves and analyzes user's mental state. Paper presents details of the endeavor.

I. INTRODUCTION

Living creatures are the ultimate example of an autonomous system for functions like survival and self defense. However, the autonomous functions of humans are subtle. The two types of autonomy can mainly be divided as 1) where the function is through conscious brain activity and 2) the functions are not through brain activity viz. the rhythmic heart function in a healthy body. In the other case, events of real world outside the human body perceived by the senses lead to actions which may seem to be voluntary, like a flashing lamp induces eyelid closure, a projectile reaching the body induces arm motion to save the body by stopping it, but experiences have shown that under certain conditions the self saving reaction does not occur. For example, a very sudden frontal attack seen by a subject may impair reactive actions owing to being overwhelmed by high brain activity. In such case, though the subject is not able to act, device like a 'Taser' can act by itself using the pertinent brain activity sensed by the external electronic aid. [1]

The project aims at building an autonomous combat mechanism based on Electroencephalography (EEG) [2] that generates an electronic output in response to them.

II. ORIGINALITY OF AN IDEA

The primary idea is to use the brain waves to infer the state of the person and accordingly take precautionary actions for it automatically. The idea was a result of numerous brain storming sessions over the enhancement of the concept of Human-Machine interface and its extension towards the automated use. The present social evils actuated us to enhance this technology for targeting social issues like rapes, murder, etc.

However, specifically, we were inspired by the idea of Brain-Computer Interface. The technology of Brain-Computer exists in today's world, though not on commercial and wide scale. We were of the opinion that if the inanimate entities in the world can act based on the brain's status, and then the problem of coding, calculating and run-time decision making can be eradicated. It can take decisions on evaluating the state of the brain. This makes the process faster and easier. Thus, the idea started with the intentions of developing new technology to work towards the above mentioned aims for welfare of people.

III. TECHNICAL BACKGROUND

All the crimes which are directed towards women are categorized as 'crimes against women'. A total of 2, 44,270 crimes against women have been reported in 2012 as compared to 2, 28,650 cases reported in 2011 indicating an overall 6.4% increase in the year 2012. Out of which 24,923 cases were of rape and 38,262 cases were related to kidnapping and abduction [3]. In many of the cases victim facing the trauma experiences the freezing of logical thinking. So in order to avoid such trauma an automated protective device is necessary. EEG is recording of electrical activity of scalp. The protective device records EEG and analyzes it. Once it detects some imbalance in EEG data or matches the EEG data with frequencies relating fear it should trigger the protective device.

Weapons for self defense are useless if the victim is physically unable to respond to threats because of temporary paralysis experienced in such situations or due to permanent physical handicap. In addition, effective usage of such weapons requires adequate

practice and swift response. Manually operated devices such as pepper-sprays, knives or guns are thus, inadequate for self defense. A voice or gesture-controlled device also requires deliberate actions on the user's part. The challenge here is to eliminate the requirement of any physical action initiated by the user still ensuring protection of the individual.

The ingenious solution to the above requirement is to make use of a person's inherent feeling of fear when facing threat, for activation of a self defense mechanism, in this case a taser to immobilize the assailant temporarily. This removes the need for victim's initiation, simultaneously decreasing response time and giving him/her adequate opportunity to get away.

IV. PROPOSED SOLUTION

The solution lies in building an integrated system to operate the aforementioned device as its subsystem in coordinated manner. We propose to build the electronic circuit for Taser. The intelligence is built in the microcontroller based on finite state automata implementation, as the approach offers programmability for behavior coding, flexibility to support iterative changes in test phases for evolving the optimum solution and future upgrade like communication with external devices for data upload. Complete hardware based solution, though possible, lacks crucial flexibility. Taser excitation needing interactive body sensed parameter based direct functions is self-contained and receives auxiliary commands from the coordinator.

V. IMPLEMENTATION

For a country of 1,241 billion people (World Bank), 244,270 may not be a startling number, but when more than 244,270 (Reuters (2012)) crimes are reported annually, it becomes vital to look for a solution. Though there has been a rise in crimes by 6.83% in every quarter, the number of cases registered and the assailant being caught hasn't increased in the past years(considering the 70.2% Indians being mobile phone users). The reason for this inability is called the "fear and freeze response". 40% victims experience some kind of symptoms of paralysis, no physical ability to think or call for help. Thus, existing devices like pepper-sprays, knives or guns are inadequate for self defence [4]. The solution lies in building a 'Taser' that is stimulated by the fear frequency detected by the EEG device.

To implement a taser, LM555 (refer figure 2) has been used as an astable multivibrator for which both states are quasi-stable. The operation of an astable multivibrator is similar to that of a monostable multivibrator except that the capacitor C1 charges through R1 and R2 and the discharge path is through R2 only. Thus, the charging time constant is (R1 + R2) *C and the discharging time constant is R2*C. With the discharging of capacitor, trigger voltage at inverting input of comparator 2, i.e. pin 6 decreases and when this value becomes less than +1/3 VCC, the output becomes low. Thus, there is auto-transition between the two states and the cycle repeats.

When Q is low or output VOUT is high, the discharging transistor is cut-off and the capacitor C begins charging toward VCC through resistances RA and RB. Hence, the charging time constant is (RA + RB) C. Eventually, the threshold voltage exceeds +2/3 VCC, the comparator 1 has a high output and triggers the flip-flop so that its Q is high and the timer output is low. With Q high, the discharge transistor saturates and pin 7 grounds so that the capacitor C discharges through resistance RB with a discharging time constant RB C. With the discharging of capacitor, trigger voltage at inverting input of comparator 2 decreases. When it drops below 1/3VCC, the output of comparator 2 goes high and this reset the flip-flop so that Q is low and the timer output is high. This provides the auto-transition in output from low to high and then to low as, illustrated in figures. Thus, the cycle repeats.

C. Figures and Tables

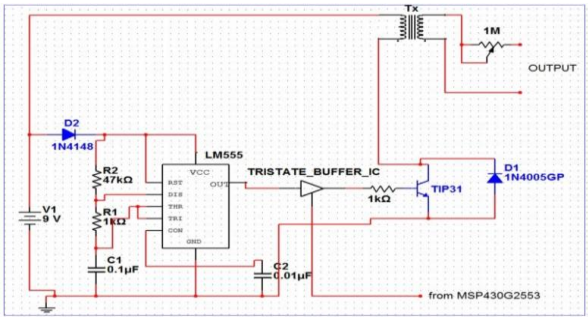

Fig 1. Circuit diagram of Taser.

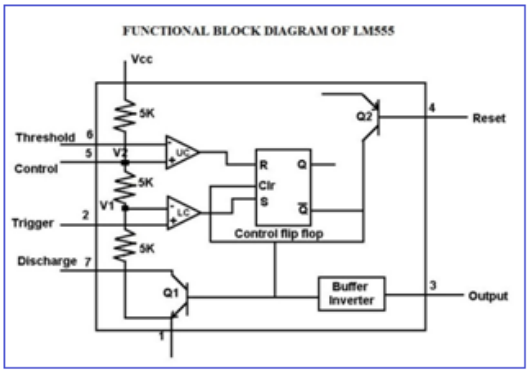

Fig. 2. LM555 internal diagram

Following is the simulation output for taser circuit. The circuit for Taser functioned as expected. The out captured by the scope of multisim appears as under shown

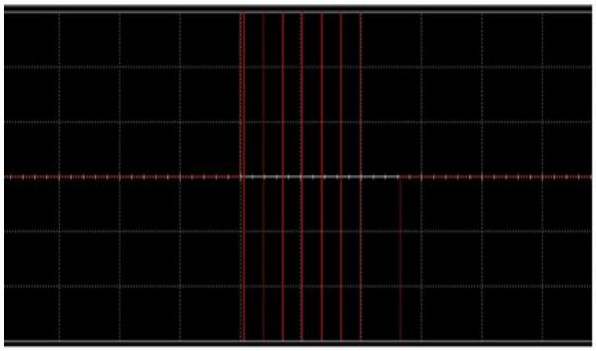

Fig 3 Output of Taser for the condition;. Pulse Amplitude- 3.5 V, Pulse Duration- 0.1 sec

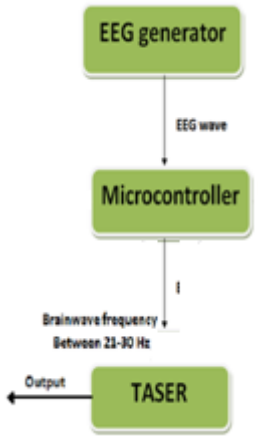

Fig. 4. Block diagram

TABLE I. FREQUENCY BANDS OF BRAIN WAVES

Band	Frequency
Delta	less than 4 hz
Theta	4-7 hz
Alpha	8-13 hz
Beta	14-30 hz
Gamma	Above 30 hz

Fear frequencies come under Beta waves.

VI. TECHNICAL CHALLENGES

The first major challenge that we faced during the initial development stage was the non-availability of any medical equipment for observation and research into the generation and propagation of electrical signals inside the human body. To improve our understanding of EEG signals, we did extensive literature survey and also got help from doctors in visualizing the functions.

The second major challenge was our inability to test our circuits on patients. As a result, we had to demonstrate the outputs of the system as electrical signals and our hardware testing was limited to simulations and voltage, current measurements. Also, for demonstration purposes we were forced to limit the output values to measurable voltages and time durations which are significantly higher than actual in case of taser for safety adherence.

VII. ADDITIONAL FEATURES

The Taser subsystem of our project would be enhanced if it included a camera to capture the image of the assailant on triggering, so that after the victim escapes, proper action can be initiated against the attacker using the captured image as the proof. Since the trigger is the feeling of fear, there is no scope for false allegations and the proof is authentic.

A. Abbreviations and Acronyms

EEG - Electroencephalography

B. Units and Numbers

Hz – hertz

VIII. CONCLUSIONS

Thus we can successfully implement a working prototype consisting of the proposed subsystems with several improvements. Future scope may include a spring loaded projection mechanism to throw the taser at the adversary. A compact camera triggered by the same taser triggered circuit can capture the picture of the assailant. Also, the trigger of the Taser can activate a system which will raise a distress alarm and send text messages to five emergency numbers with the GPS location of the victim to receive sustainable support after the initial setback caused to the adversary.

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REFERENCES

[1] Controlling Assistive Machines in Paralysis Using Brain Waves and Other Biosignals, Paulo Rogério de Almeida Ribeiro, Fabricio Lima Brasil, MatthiasWitkowski, Farid Shiman, Christian Cipriani, Nicola Vitiello,

Maria Chiara Carrozza, and Surjo Raphael Soekadar, Volume 2013, Article ID 369425, Hindawi Publishing Corporation, Advances in Human-Computer Interaction

[2] FUNDAMENTALS OF EEG MEASUREMENT, M. Teplan, Institute of Measurement Science, Slovak Academy of Sciences, Dúbravská cesta 9, 841 04 Bratislava, Slovakia, MEASUREMENT SCIENCE REVIEW, Volume 2, Section 2, 2002

[3] Crime against Women - National Crime Records Bureau http://ncrb.nic.in/CD-CII2012/cii-2012/Chapter%205.pdf

[4] Risks and Benefits of Tasers, Anthony Paul Butski Eastern Michigan -University Ypsilanti, Mi.

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