# Carnegie Mellon

## **Traveling Mind: EEG Controlled Game**

Electrical & Computer ENGINEERING

Table 2: User Test

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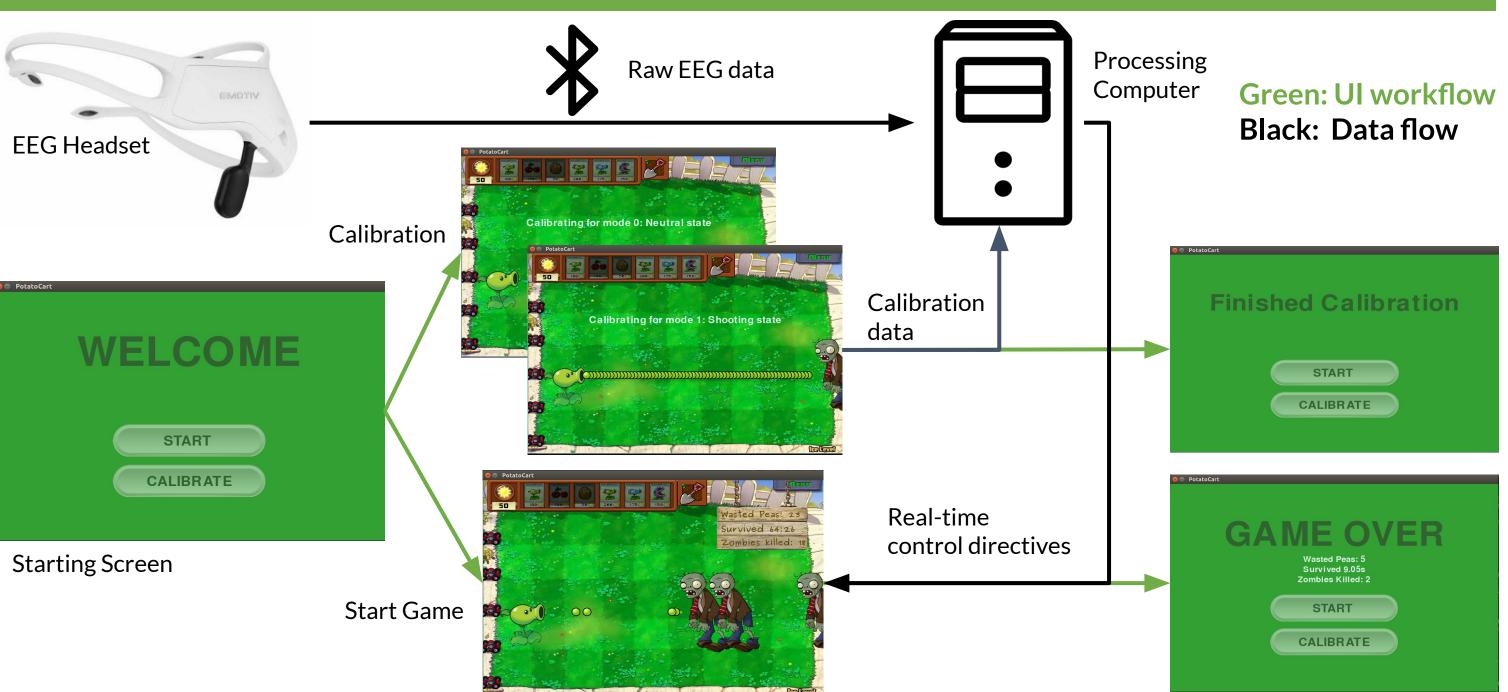
#### **Product Pitch**

Our team develops a mind controlled game, where users fight waves of zombies as the lone peashooter. The system reads user's brainwave signals via a EEG headset and identifies the control intentions - shoot or hold - from the signal patterns. The software stack could be used in other scenarios too, e.g. enabling people with locomotor disabilities to seamlessly command the compute agents.

Our system is thoroughly tested by 3 different users and after some training, 2 of them are able to survive the game for more than 20s and effectively assert their control intentions for more than 3s.

#### **System Architecture Emotiv Brainware** Layer n, n in {1,2,3,4} Calibrate Temporal Conv2D Bluetooth for n=1**Emotiv App** Start Channel-wise Conv2D LSL End Denoiser **Batch Normalization** FIR Bandpass Filter **User Interface** 4 - 35 Hz **ELU Activation Ocular Artifact** Key Dropout Removal Off-the-Shelf **EMD** from Emotiv Maxpool for n>1 **Software Module** Software Submodule Flatten + Activation NN Sublayer **Neural Network**

### System Description



#### **System Evaluation**

Table 1: System Test

Table 1: System Test				Table 2: User Test			
Test Category	Test Name	Result / Criterion	Pass	Test Subject	Test Name	Result / Criterion	Pass
Denoising	Ocular Effect Removal	Blinking Spikes Look Attenuated	Y	Chris	Shoot Peas	3s / 3s	Υ
Denoising	Fidelity of Cleaned Signal	0.83 / > 0.65	Y	Chris	Not Shoot	3s / 3s	Υ
				Chris	Survive	20s / 20s	Υ
Denoising	Latency	0.0035s / <0.01s	Y	Tianyi	Shoot Peas	3s / 3s	Υ
Neural Network	Max Binary Classification Accuracy	~80% / >70%	Y	Tianyi	Not Shoot	~1s / 3s	N
				Tianyi	Survive	~17s / 20s	N
Neural	Latency	0.05s / <0.1s	Υ	Eryn	Shoot Peas	3s / 3s	Υ
Network	Latanavi	0.0100 / 40.40	V	Eryn	Not Shoot	3s / 3s	Υ
UI Rendering	Latency	0.012s / <0.1s	Y	Eryn	Survive	20s / 20s	Υ