

基於失智者心智訓練及互動藝術之 OLED 照明裝置

OLED Lighting Device for Dementia Patients Based on Mental Training and Interactive Art

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研究領域

軟顯示器電路設計、再生能源最大功率追蹤系統、生醫電子系統。



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研究領域

擴增實境應用、人因互動設計、人機互動、虛擬實境應用。

由於近年來臺灣高齡人口快速增加，盛行於中高齡族群之失智症人口也隨之增長。根據統計資料顯示全臺 65 歲以上老人共有 340 萬，其中失智症患者共有 27 萬人，且預估於 2065 年將達到 65 萬失智人口，故老人需要有一套能夠延緩老化，又能結合互動且有趣的智慧產品。這套產品需要以簡單、輕鬆、容易操作為原則，幫助老人訓練反應力、注意力、協調力以及記憶力，以改善日常的生活品質。

因此，本團隊提出可進行認知訓練遊戲之 OLED 互動照明裝置並將作品設置於成大醫院進行測試，使用者需記憶 OLED 互動照明裝置發光順序，並透過依序觸碰 OLED 互動照明裝置答題，答題過程中系統記錄使用者作答之資訊作為測試資料，利用多種分類器建立一基於投票機制之人工智慧 (AI) 演算法模型，以此評估使用者目前失智情況，令使用者能及早發現失智徵兆，提前進行治療來避免失智症惡化，並且藉由長期間時提取訓練使用者可達到延緩失智症之效果。此外，本團隊亦對使用者進行問卷訪談來了解使用者對作品的建議與感想，從問卷回饋中得知使用者在具趣味性與挑戰性之遊戲互動中皆有愉悅的表現，表示此系統能吸引專注並有效舒緩使用者之情緒。

以下簡述本團隊所設計之 OLED 互動照明裝置之特點：

1. 直覺式互動控制系統：

透過讓高齡者觸碰 OLED 照明裝置來進行互動式的記憶測試，可達到訓練高齡者的記憶能力、身體協調能力及反應力，延緩隨年齡增長所導致之記憶與身體衰退問題。

2. 遠端醫療監控系統：

使用者之測試資料會藉由手機上傳至雲端資料庫，不僅能使使用者透過雲端獲取互動遊戲資訊，所儲存之數據更可供 AI 演算法分析進行早期失智檢測，醫護人員亦可由此評估高齡者記憶力之表現狀況。

3. 失智程度評估功能：

本團隊以遊戲出題難度及答題時間做為失智風險評估之特徵項 (features)，並透過多種分類器進行失智症風險評估，再以投票表決之決策方式 (voting-based) 提升評估之強健性。進而判斷其記憶力是否退化，以利失智症初期進行相關診療及復健。

本裝置特別感謝成大神經部主任林宙晴醫師與失智專科門診宋碧嫻醫師給予失智症之專業知識分享，並提供院內照護場域作為本系統之功能驗證及協助本裝置之人體試驗審查 (IRB) 申請等相關事宜。

Due to the rapid increase in the Taiwanese elderly's population in recent years, the middle-aged and old-aged people with dementia have also increased. According to official investigation, there are 3.4 million elderly people over 65 years old, including 270,000 people with dementia, and the demented population is estimated to reach 650,000 in 2065. Therefore, an interactive and interesting smart product is required to relieve the deterioration of the elderly's memory. This product needs to be operated easily to help the elderly train their reaction, attention, coordination, and memory, maintaining or improving the quality of daily life.

Therefore, our team proposes an OLED interactive lighting device and tests the functionality in NCKU Hospital that can perform cognitive training games. The users memorize the lighting sequence of the OLED, and repeat the sequence by touching the OLED panels. During the task process, the system records the user's test results as the examined data that is introduced to various classifiers for establishing an artificial intelligence algorithm model based on the voting mechanism. Through the proposed algorithm, the dementia degree of the user is evaluated to make user perceive the sign of the dementia as early as possible and treat the disease to prevent the deterioration of the dementia. Moreover, the effect of relieving dementia is achieved by the long-term spaced retrieval training method. Furthermore, the interview based on questionnaire is conducted to understand the user's suggestions and feelings about the proposed design. From the feedback of the questionnaire, the subjects give positive comments on the interesting and challenging interaction game, indicating that the proposed system can increase concentration and effectively relieve the user's mood.

The characteristics of the proposed OLED interactive lighting device are as follows:

1. Intuitive interactive control system:

By taking the memory test which is designed on the OLED lighting system, the elderly can improve their memory ability, reaction capability and physical coordination ability, relieving the memory and physical decline with age.

2. Remote medical monitoring system:

The user's test results are uploaded to the cloud database through the mobile phone, which allows the user to check the profile stats from the cloud database. The data stored in the database is analyzed by artificial intelligence (AI) to provide a diagnosis of dementia in advance. Moreover, the medical staff assess the performance of the elderly's memory by the diagnosed results.

3. Dementia assessment:

To diagnose the user's risk of suffering from dementia, the difficulties and the complete time of the test are used for dementia assessment. Also, the risk is evaluated by various classifiers, and the robustness of the dementia is determined by a voting-based method. Through measuring the deterioration degree of the user's memory, the proposed system is conducive to the relevant diagnosis and rehabilitation of the early stage of dementia.

About the device, we highly appreciate that Dr. Chou-Ching Lin, the Director of the Department of Neurology of Cheng Kung hospital, and Dr. Pi-Shan Sung, a specialist in the Department of Dementia, share the knowledge of dementia disease, provide the hospital care field as the function verification of the system, and assist in applying for NCKUH IRB of the human study trial.



圖 1. OLED 互動照明裝置實體圖



圖 2. 帶領使用者進行認知訓練



圖 3. 於成大醫院進行數據收集