從 CRT 到 AR 的智慧顯示器

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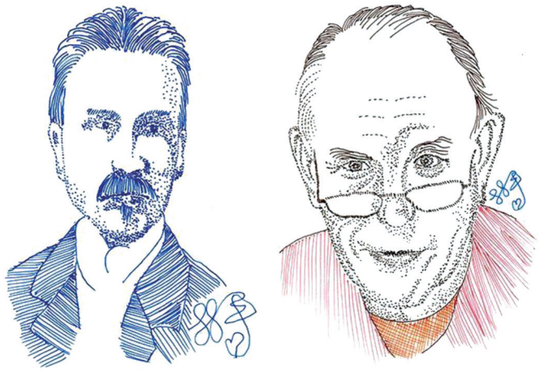

林一平手繪之羅辛與蘇德蘭。

最近我們利用 AR 眼鏡，接上 5G 手機，在白草莓園溫室進行智慧農業教學，成效非常好。運用場域包括中華電信的板橋羅丹農場、新竹寶山農場，並在彰化縣農業處的「智慧農業推廣中心」揭牌正式啟用時展示。

致詞時我說，非常感謝彰化縣讓我們有機會將產官學的相關技術能夠在彰化落地，也感覺彰化縣的青農們都非常有意願要試行，覺得有機會可以做的非常好，於是請廣達量產智慧感測器及 AI 平台，整個物聯網的部分以及 AR 眼鏡技術經由中華電信導入，將全國最好的組合整合一起，希望讓彰化縣在智慧農業上變成一個世界的楷模。

AR/VR 眼鏡是智慧顯示器。電腦或手機最重要的輸出裝置是顯示器螢幕 (Screen)，其技術由早期的 CRT(Cathode Ray Tube) 演進到 LCD(Liquid Crystal Display)、LED(Light-Emitting Diode)、 氣體電漿顯示 (Gas Plasma) 或其他影像投射技術。隨著 5G 網路及工業 4.0 的發展，智慧穿戴技術的發展將成為消費電子的下一個殺手級應用。經由智慧穿戴技術發展智慧眼鏡的研發技術，成為最有潛力的顯示器螢幕。

早期 CRT 的技術是德國物理學家布勞恩 (Ferdinand Braun) 於 1897 年的發明，亦稱為布勞恩管 (Braun tube) ，最早用於示波器的顯示。在德國，CRT 被稱為 Braunsche R hre，而日本則稱為 Buraun-kan。這個技術應用了 100 餘年才被平面顯示技術取代。

布勞恩在發明 CRT 技術的期間也研究二極體 (Crystal Diode Rectifier)，並在 1898 年發明了我們俗稱的貓鬚 (Cat's Whisker Diode)。在無線通訊的研究上，馬可尼 (Guglielmo Marconi) 「借用」了不少布勞恩的成果，後來兩個人於 1909 年共同獲頒諾貝爾物理獎。

1907 年，俄國科學家羅辛 (Boris Lvovich Rosing) 將 CRT 用來接收並顯示影像訊號，發明了電視機。羅辛持續改進電視機的技術直到 1931 年。這一年他因為反革命被放逐到科特拉斯 (Kotlas)，政府不准他再做研究。他於 1933 年因為腦溢血死於放逐流離之時。

羅辛的發明其實是延伸了德國科學家尼波隆 (Paul Julius Gottlieb Nipkow) 設計的旋轉鏡片及鏡子的機械系統。羅辛使用機械式的攝影機拍攝影像，再以 CRT 接收。在 1970 年代初期，CRT 開始用於電腦螢幕來顯示文字。1981 年，IBM 推出 4 種顏色的彩色顯示器 (Color Graphics Adapter；CGA) ，並於 1984 年將顏色增加到 16 種。到了 1990 年就有全彩的高解析度螢幕。

關於顯示器技術，早在 1968 年就很先進，由美國 ARPA 信息處理技術辦公室主任蘇德蘭 (Ivan Edward Sutherland) 建立了「達摩克裏斯之劍」頭盔顯示器，被公認為是世界上第一個頭盔顯示器，能顯現 2D 圖像。今日 iPhone 及其他智慧型手機，皆採用先進的平面觸控螢幕；3D 的顯示螢幕亦已有產品；今日更有穿戴式擴增實境 (AR) 眼鏡。最好的 AR 眼鏡是台灣的產品，我們用來展示 5G 智慧農業，真正是台灣之光。

Smart Displays: From CRT to AR

We recently used AR glasses and 5G mobile phones to conduct smart agriculture teaching in the White Strawberry Garden Greenhouse, and the results were very impressive. Then the application fields extended to Banqiao Rodin Smart Farm of Chunghwa Telecom and Hsinchu Baoshan Farm. They were demonstrated in the official opening ceremony of the "Smart Agriculture Promotion Center" of the Changhua County Agriculture Department.

During the speech, I said, “I am very grateful to Changhua County for granting us the opportunity to deploy related technologies through collaborations of industry, government and education in Changhua. I can feel that many young farmers in Changhua County are willing to try new approaches and have the confidence to get things done well. Therefore, we are cooperating with Quanta Computer to mass-produce smart sensors and set up the AI platform, as well as with Chunghwa Telecom to introduce the technology of the Internet of Things and AR glasses. We hope this integration, the best nation-wide, can build up a world-class smart agriculture model in Changhua County.

AR/VR glasses are smart displays. The traditional main output device of a computer or mobile phone is the display screen, which has evolved from the early CRT (Cathode Ray Tube) to LCD (Liquid Crystal Display), LED (Light-Emitting Diode), Gas Plasma Display (Gas Plasma Display), and recent other image projection technology. Along with the development of the 5G network and Industry 4.0, smart wearable technology will become the next killer application of consumer electronics. Based on smart wearable technology, smart glasses would become the most potential display screen.

In 1897, German Physicist Karl Ferdinand Braun invented the earliest version of CRT technology. The CRT is also known as the Braun tube, which was initially applied to an oscilloscope. It is still called Braunsche Röhre in German and Buraun-kan in Japanese. CRT technology was in use for more than 100 years before it was supplanted by flat-panel display technologies.

Aside from inventing CRT technology, Braun also researched the Crystal Diode Rectifier and created the so-called cat's whisker diode in 1898. In wireless communications development, Guglielmo Marconi leveraged quite a few Braun's achievements so later they jointly received the Nobel Prize in Physics in 1909.

In 1907, Russian scientist Boris Lvovich Rosing used CRT to receive and display video signals in the creation of a television system. Rosing continued enhancing his television until 1931, when he was exiled as a counter-revolutionary to Kotlas and prohibited from conducting research. He died of a cerebral hemorrhage in exile in 1933.

Rosing's invention is actually an extension of the mechanical system of rotating lenses and mirrors designed by German scientist Paul Julius Gottlieb Nipkow. Rosing adopted a mechanical camera to capture images and a CRT to receive signals. In the early 1970s, CRTs began to be used to design computer screens for displaying text. In 1981, IBM introduced a 4-color Color Graphics Adapter (CGA) and increased its color depth to support 16 colors in 1984. By 1990, full-color high-resolution screens were introduced to the public.

Display technology was quite advanced as early as 1968. Ivan Edward Sutherland, the head of the US ARPA Information Processing Technology Office, created the "Sword of Damocles" a head-mounted display with two-dimensional tracking capabilities, which is widely considered to be the first virtual reality headset in the world. Nowadays iPhones and other smart phones have advanced flat-panel touch screens; even 3D display screens are available. Moreover, wearable augmented reality (AR) glasses are on the market and the best AR glasses are products from Taiwan. We use them to demonstrate 5G smart agriculture, and they truly are the light of Taiwan.