Table 1. Digital technology index: Summary of studies included in clinical review.

Study	Technology name	Technology type	Cognitive target	Development stage	Participants	Primary outcome	Result
Smartphone Applications							
Brouillette et al. (2013)	Colour-Shape Test (CST)	Smartphone application	Processing speed	Proof-of-concept	57 healthy older adults. Age: mean 67.18 years (SD ± 1.02)	Comparison of performance on app with scores on standard assessments of cognitive processing speed and cognitive function.	Scores on CST significantly positively correlated with global cognition (as measured by MMSE), processing speed and attention (as measured by digit span, trail making and digit-symbol test). Test-retest reliability was significant.
Hartin et al. (2014)	Technology Adoption and Usage Tool (TAUT)	Smartphone application	Prospective memory	Proof-of-concept	9 healthy younger adults. Age: median 27 years	Adherence to reminder alerts	73% of reminder alerts were acknowledged (within a mean response time of 12.38 seconds), despite 80% of reminders interrupting the participant during another activity. Reminders for all ADL categories available were used.
Hill et al. (2017)	Modified Attention Training Application (ATA)	Tablet application	Attention	Proof-of-concept	12 older adults without moderate-severe cognitive impairment. Age: mean 79 years (SD ± 4.2)	Feedback on the usability and acceptability of the app for attention training.	On average participants rated the app positively (60% or higher). A preference for challenge, speed and variety was demonstrated. Main limitations included: lack of engagement, technical difficulties and confusion regarding use.

Jongstra et al. (2017)	iVitality	Smartphone application	Working & short-term memory, attention, executive function	Proof-of-concept	151 healthy older adults with parental history of dementia. Age: mean 57.3 years (SD ± 5.3)	Feasibility and validity of smartphone-based neuropsychological tests to assess various aspects of cognitive function.	The app version of the Stroop and TMT moderately correlated with performance on the conventional test versions. Performance on the app Stroop and TMT reversed alphanumeric tasks improved with repeated testing. Mean adherence to assigned smartphone tests was 60% at 6 months.
Oh et al (2017)	Smartphone-based brain Anti-Ageing and memory Reinforcement Training (SMART) and FitBrains©	Smartphone applications	Attention, working memory and executive function	Validation	53 older adults with subjective memory complaints. Age: mean 59.3 years (SD ± 5.09)	Subjective and objective improvements in memory (as measured with standard questionnaires) post-app use.	Total and auditory-verbal working memory scores increased significantly in the SMART group compared to both control groups. However, self-reported memory contentment only significantly improved in the FitBrains group.
Shellington et al. (2017)	Health*e*Brain	Smartphone application	Visuospatial memory	Proof-of-concept	19 healthy or mildly cognitively impaired older adults. Age: mean 68.3 years (SD ± 5.4)	Feedback on the usability of the app to deliver exercise-based, visuospatial tasks outside the lab.	19/95 contacted participants successfully downloaded the app and completed the survey. 60% of participants found the app easy to use, or similar to previous experiences. 9 participants said they would continue to use the app in the future.
Tieges et al. (2015)	DelApp	Smartphone application	Visual sustained attention	Proof-of-concept	156 older hospital inpatients (50 with delirium, 52 with dementia and 54 with no cognitive	Ability of smartphone based test of visual sustained attention to reliably differentiate patients with delirium from those with dementia.	DelApp scores differed significantly between all 3 groups (delirium<dementia<controls). ROC analyses revealed excellent accuracy of the DelApp for discriminating delirium from dementia (AUC = 0.93), and delirium from controls (AUC = 0.99).

					impairment). Age: IQR 70-91 years		
Wearables							
Ahanathapillai et al. (2015)	Wrist Wearable Unit (WWU)	Smartwatch system	Activities of daily living	Proof-of-concept	Healthy younger adults. Age: range 20-50 years	Ability of system to detect and record activity related measures in order to infer behavioural patterns.	Activity level calculations from long term device usage, correlated with participants' self-reported activity levels.
Boletsis et al. (2015)	Basis B1 Smartwatch	Smartwatch system	Activities of daily living	Proof-of-concept	1 patient with advanced dementia and 1 professional caregiver	Feasibility and validity of smartwatch-based measures to assess daily activity function.	Caregiver able to extract useful information about patterns in patient's behaviour (sleep, exertion) and changes to this pattern. Issue with steps not registering when patient used a walking frame support.
Browne et al. (2011)	SenseCam	Wearable camera system	Declarative memory	Proof-of-concept	1 adult with mild cognitive impairment. Age: 56 years	Efficacy of camera system to aid recall of significant personal events.	The proportion of events recalled was significantly higher over 2 weeks when using the SenseCam review (68%), than when relying on a diary (38%) or not actively cueing memory (30%). At 6 months this difference in recall between groups was still present.
Cachia et al. (2014)	WanderRep	Smartwatch system	Wandering	Proof-of-concept	1 patient with dementia and 5 professional caregivers	Ability of system to differentiate dangerous wandering scenarios from normal	WanderRep had a 78% sensitivity to detect pre-determined dangerous scenarios based on temperature, activity level, location and time.

						movement and activity.	
Firouzian et al. (2015)	Indicator-based Smart Glasses	Smart glasses	Navigation	Design	Not specified	Usability of smart glasses system to provide visual, navigational cues.	The most distinguishable positions, frequency and brightness of LED lights for forming visual cues were determined. Need to develop and pilot a user-friendly interface and more lightweight device.
Matthews et al. (2016)		Wearable camera system	Activities of daily living	Proof-of-concept	18 people with dementia (age: mean 78.6 years, SD ± 9.1) and their primary caregivers (age: mean 63.7 years, SD ± 14.0)	Ability of the system to capture episodes of dementia-related behaviour or caregiving interactions.	A total of 341 hours of usable video was obtained, yielding capture of 248 salient events.
Netscher (2015)	Max	Smartwatch system	Activities of daily living	Proof-of-concept	13 healthy participants from the Dementia Care Ecosystem study	Ability of system to measure users' routine behavioural patterns and detect outliers or declining trends.	Room detection accuracy 96.1% ± 2.6%. Reliable behaviour modelling possible with missing data i.e. when the user forgot/chose not to wear the device.
Shin et al. (2014)	u-Healthcare	Smartwatch system	Activities of daily living	Proof-of-concept	8 participants	Ability of the system to monitor users' location, physical activity and sun exposure.	The system had on average a 94.7% accuracy in detecting steps. User profiles of activity were then produced based on steps, demographic information, GPS information and light sensor data.

Stubbs et al. (2017)		Wearable accelerometer system	Activities of daily living	Validated	274 community-dwelling older adults. Age: mean 74.52 years (SD ± 6.12)	Efficacy of objectively measured levels of physical activity to predict cognitive stability in older adults.	Light and moderate physical activity as measured by the accelerometer were both significantly associated with a reduced rate of cognitive decline over 2 years, with light physical activity associated independently.
Thorpe et al. (2016)		Smartphone applications and smartwatch system	Activities of daily living	Proof-of-concept	5 patients with dementia and their spouses. Age: range 61 to 73 years.	Usability of integrated wearable and smartphone system to assist people with dementia with completion of daily activities.	Scheduling, communication and orientation tasks had a 100% completion rate, but navigation/ emergency help tasks had a 0% completion rate.
Smart Homes							
Arcelus et al. (2007)	Technology Assisted Friendly Environment for the Third age (TEFETA)	Smart home	Activities of daily living	Design	No formal data collection	Investigating the benefits and limitation of the design.	May provide more independence for users, be an economical alternative to 24 hour care, and able to detect subtle changes in behaviour. However it could be considered intrusive, be rejected by users uncomfortable with technology or users may develop a false dependency on the technology.
Hall et al. (2017)		Smart home	Activities of daily living	Validation	24 care staff, age: mean 39.75; 3 residents with dementia, age: mean 81.33; 9 relatives, age: mean 55.67	Explore facilitators and barriers to the implementation of monitoring technology.	Core reason for use was to enhance resident safety and freedom, outweighing ethical concerns; technology was perceived as simple to use, but staff wanted more formal training. Frequent alarms were generate and staff had to rely on contextual knowledge to decide when to respond.

Stravropoulos et al., (2016)	DemaWare2	Smart home data modelling framework	Activities of daily living	Validation	98 AD, MCI or control participants in lab environment (age: range 60–90); 2 amnesic and 2 dementia in residential environment	Evaluation of DemaWare2 modelling in recognising ADL in laboratory and residential environments.	Activity recognition recall and precision close to 82% in lab-environment and 83% and 76% (respectively) in residential environment for most ADL; however, recognition varies depending on ADL. Can differentiate cognitively healthy, MCI and AD patients with up to 84% accuracy. High user acceptability.
Ishii et al. (2016)	M2M (Machine-to-Machine)/ IoT (Internet of Things) platform	Smart home data modelling framework	Activities of daily living	Validation	Pseudo patient data	Evaluation of modelling platform in recognising ADL.	Accuracy rate in determining behaviour was between 80-100% for most activities but was lower (30-40% accuracy) for forgetting to turn off the TV.
Dawadi et al. (2013)		Smart home data modelling framework	Activities of daily living	Validation	16 dementia patients, 51 MCI and 196 cognitively healthy participants grouped in 4 age ranges	Evaluating modelling framework in making ADL performance predictions compared to clinical observations and capability of dementia status predictions.	A correlation (r=.54) between the direct observation scores and predicted activity quality when combining scores from all 8 activities; individual activity correlations varied. Reasonable classification accuracy in classifying participants into groups: dementia and cognitively healthy but not MCI.
Lyons et al. (2015)	Oregon Center for Aging and Technology (ORCATECH)	Smart Home	Activities of daily living	Longitudinal cohort study	480 smart homes; Users over the age of 70, MMSE>24, CDR <0.5, on enrolment.	Presenting results from the last 8 years.	ADL results for sleep, computer use, medication adherence, movement, social engagement and a multi-domain approach have been used to predict outcomes such as low mood, loneliness, and cognitive function; potential shown to improve quality of

							patient data related to cognitive decline.
Kaye et al. (2014)	Oregon Center for Aging and Technology (ORCATECH)	Smart Home	Activity of daily living	Longitudinal cohort study	38 MCI patients, age: mean 84.6 (SD ± 4.8), 75 cognitively healthy older adults, age: mean 84.6 (SD ± 4.3)	Assessing ability of unobtrusive smart home to monitor computer use, detect mild functional changes and identify MCI.	No difference in computer use at baseline, but years 2 and 3 showed significant decrease in number of days with use, mean daily use and increase in day-to-day variability in computer use for MCI compared to healthy participants; indicating computer use can differentiate individuals with MCI.

Activities of daily living (ADL), Alzheimer's Disease (AD), Area under the curve (AUC), Clinical Dementia Rating (CDR), Colour-Shape Test (CST), Global positioning system (GPS), Interquartile range (IQR), Light emitting diode (LED), Mild Cognitive Impairment (MCI), Mini–Mental State Examination (MMSE), Receiver operating characteristic (ROC), Smartphone-based brain Anti-Ageing and memory Reinforcement Training (SMART), Standard Deviation (SD), Trail Making Tests (TMT).