INTRODUCTION
The aim of this thesis was to develop a prototype At-Home Testing Device (AHTD) to monitor the progression of Parkinson’s Disease (PD). The device was to be capable of identifying and gauging the severity of core symptoms presented in PD, notably:

- **Tremor**: shaking or trembling motion
- **Rigidity**: stiffness of muscles
- **Bradykinesia**: slowness of movement

It was also desired that the device improved upon current products and testing methods in terms of accessibility, affordability, usability and simplicity.

Persons with PD are affected differently with respect to presented symptoms and the disease’s progression (Parkinson’s Australia 2008). This fact combined with the lack of pathological tests or identifying markers make PD difficult to diagnose (parkinsons.com.au 2010). The development of an affordable device which could monitor this progression at minimal inconvenience would:

- Improve patient quality of life
- Provide more insight into PD

Current methods for monitoring PD were surveyed and assessed on their ability to obtain the desired information without the supervision of a trained medical professional. From this assessment it was determined that a pegboard dexterity test provided opportunity to develop a user friendly, affordable product with the ability to produce quantifiable results for core symptoms of PD (Haaxma. C. et al 2008).

MATERIALS AND METHODS
Device Design
Designed to encourage frequent and consistent use at minimal inconvenience to the patient, the device consists of:

- **Peg**: Battery powered and fitted with a 3-axis accelerometer to track a subject’s movement path.
- **Pegboard**: Contains light emitting diodes (LEDs) and optical switches to indicate and track peg removal and placement.
- **Standard computer**: Used for data collection, storage and signal processing tasks.

Data received during operation of the device is collected using Matlab and stored in report format for analysis and comparison.

Testing Methods
On starting a test the subject is required to:

- Move the peg from the home position
- Place peg in the position highlighted by a red LED (Figure 1).
- Wait until a new position is highlighted
- Remove the peg from the current position and place it in the new position.

The adopted testing-method for clinical testing of the device involved conducting nine sets of tests twice daily. These nine tests consisted of three pre-set and repeatable paths. During a sitting the subject would complete each of the paths three times for each the right and left hands.

In order to ensure the results of clinical testing corresponded accurately to “ON” and “OFF” extremities presented in PD, the subject was required to abstain from medication prior to the first sitting, after which medication could be taken. The assistance of a PD nurse was then used in order to assess the point at which the medication had taken full effect. Once this point had been reached the final sitting was conducted.

RESULTS
Results obtained during testing were analysed using two methods. The first was the compilation of movement time, reaction time, and accelerometer data (Figure 2), enabling clear identification and assessment of any action tremor that may be present.

The second was a displacement plot of the subject’s motion path, derived from the accelerometer data and corresponding sensor positions on the pegboard (Figure 3). This visually depicted the constraints of a subject’s movement during testing, providing insight into the assessment of rigidity and bradykinesia.

CONCLUSION
The research and testing conducted using the designed AHTD establishes the validity of the design’s ability to identify and gauge the severity of core symptoms presented in PD. Results obtained showed clear, distinguishable differences of subjects with PD at extremities of their condition as well as identifiable differences in results from control subjects. These findings demonstrate the device’s potential to provide a simple, accessible, affordable, and reliable method of collecting information to aid in monitoring the progression of PD and to provide greater insight into the disease as a whole.

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REFERENCES