1. **Introduction**
   1. *Overview*

Research in human-computer interaction has experienced a renaissance recently as computing technology develops beyond the desktop & mouse model, beyond smartphones, tablets, and towards the Internet of Things, Smart Home technology & the Digital Mesh. Although these technologies have advanced at an accelerating rate the communicative interfaces have only in the last 8-10 years begun to be explored significantly.

“It has been widely believed that the computing, communication and display technologies progress further, but **the existing techniques may become a bottleneck in the effective utilization of the available information flow**. To efficiently use them, most computer applications require more and more interaction. For that reason, human-computer interaction (HCI) has been a lively field of research in the last few years.” (Rautaray & Agrawal, 2015).

Today it is possible to turn on a washing machine from a voice controlled unit in an entirely separate location, but the main means of communicating with technology remains the WIMP paradigm, state of the art in 1995, 23 years ago. WIMP stands for Windows, Icons, Menus, and Pointers. Moore’s Law – definition and reference – has not held true for human-first user-interfaces (Turk & Ed, 2000). Moore’s Law states that the processing power (the accepted property for assigning value in the computer-hardware industry) in computers will double every two years. Almost everyone in the first world is aware of the rate at which technology is advancing, but since 1980 there has been almost no major deviation from the WIMP protocol for user interface or human computer interaction.

The author finds this incredibly remarkable, and believes that the fundamental reason for this phenomenon lies in one of the following possibilities:

1. The human-computer interaction mechanics developed for/using 80’s/90’s technology are still the most appropriate way to use technology today.

OR

1. The industry has favoured ‘tried and tested’ design instead of committing to the innovation of the user’s experience by investing in technology to develop that experience fully.

The author understands why ‘tried and tested’ design is favourable – it’s tested, designers know that it works, it’s generally accepted as a standard. Computer software is designed with mouse and keyboard in mind. However as the possibility to communicate through almost any modality (A modality is an input/output channel for information flow. Humans have 6 modalities – Vocal, Aural, Olfactory, Visual, Gesture-based & Haptic) \*\* Need to Reference Simon’s Lecture Reference\*\* has become a reality in the past few years, few of the possibilities to implement a more natural human-computer interaction have been realised.

**\*\*List the modalities, the main attempts at integrating them into HCI, and how successful they were/are\*\***

Virtual personal assistants such as Siri, Alexa and Google Assistant have become more involved in our day to day lives.

“A widely accepted prediction is that computing will move to the background, weaving itself into the fabric of our everyday living spaces and projecting the human user into the foreground. To realise this prediction, **next-generation computing should develop anticipatory user interfaces that are human-centred, built for humans and based on naturally occurring multimodal human communication**. These interfaces should transcend the traditional keyboard and mouse and have the capacity to understand and emulate human communicative intentions as expressed through behavioural cues, such as affective and social signals.”(Pantic, Nihjolt, Pentland, & Huanag, 2008)

The general topics relevant to the author’s discussion are User Experience and Human-Computer Interaction (HCI), more specifically gesture analysis and its feasibility as an interface. The IoT is a catch all term for technologies that implement sensors, data processing, communication and user interface in order to communicate with one another and form a ‘Digital Mesh.’­(McClelland, accessed on 10/10/2018) The IoT, as a technology, was featured on Gartner’s Top 10 2018 , and Smart Spaces (in the author’s view the next iteration of IoT & the Digital Mesh, expanding their scope to encompass cities rather than houses) was featured on Gartner’s Top 10 2019.

The focus of this research paper is in the areas of gesture-based communication and interface design. The factors that encourage and discourage the use of gesture, the use of OpenCV to record and analyse hand-gesture, and the use of NodeRed are explored by the author.

There is a reasonable body of research in this field, but it is growing rapidly and the author expects the research body to expand rapidly as the benefits of gesture as a means of HCI are illuminated.

The particular topics of research the dissertation focuses on are as follows:

* Hand gesture recognition
* Hand gesture analysis
* The internet of Things
* Open Computer Vision
* NodeRed
  1. *Aim of Study*

To provide an insight into the mechanics of hand gesture analysis using OpenCV. This is achieved by applying the

To analyse hand gestures and discern a lexicon, syntax and semantic structure capable of being understood as input by a software program. This is achieved by collecting qualitative data from a practical number of subjects and assessing their responses

To design a user-first interface for controlling smart lights. This is achieved by implementing interface design principles from the book ‘Lean UX.’

* 1. *Study Objectives*

To devise a research strategy capable of delivering the required information enabling the author to provide credible references and conclusions to the research question/hypothesis posed.

To gain insight into hand-gesture recognition/analysis, open cv and the Internet of Things technology.

To provide the reader with a clear understanding of hand-gesture recognition/analysis, open cv and the Internet of Things technology.

To deliver a working artefact that to display the proof of concept.

To establish the limits of the research in this area and provide a platform for further study.

To widen the author’s technical skillset by working with different languages and across different hardware and software protocols.

* 1. *Hypothesis/Research Question*

Is it feasible to use hand gestures and OpenCV to communicate with and control a SmartLight?

* 1. *Scope of Study*

The author expects the study to encompass the fields of communication – specifically gesture, User Experience –specifically human computer interaction, interface design and communications mediums in the context, gesture analysis, and IoT communications programming.

* 1. *Study Structure*

Roughly work out the skeleton here but, as per Microsoft Research paper writing doc, lay this out in introduction and forward reference from there.