**Description**  
The wristwatch has been an ever-present wearable technology since its inception in the early 1900s, and has undergone continuous technical refinement since that time. Researchers have long viewed the immediacy and ubiquity of the wristwatch as a vehicle for computation, pushing its capabilities to ever-greater heights. In 2000, IBM demonstrated the first watch running a full operating system.

One of the main reasons a wristwatch emerges as an attractive wearable device in the fact that a large fraction of the population is already accustomed to wearing wristwatches, thus favoring the learning curve for novice users. Furthermore, people generally keep watches on their wrists, and watches are less prone to be misplaced compared to phones and tablets. For example, a hip holster or pocket are not convenient places to keep a cellular phone while sitting in a car, and so people tend to keep them in the car seat and forget them when they leave the car in the parking lot. Another significant advantage of a wrist watch is that it is much more accessible than many of the other devices one may carry. It is often said that one of the reasons for the initial success of the Palm was its moving to an instant-on paradigm, i.e. eliminating the long boot up time associated with laptops. Wrist watches move users to the next step: an instantly-viewable paradigm.

From its beginnings, wearable devices have often faced a major challenge: user interface. An adequate smart phone user interface was missing for a long time. An adequate UI was the major success factor of the iPhone --the reason it was superior to all other approaches at that time. The same challenge is ahead for this new class of device: the *smartwatch*.

Unlike smartphones, which can be scaled to a variety of sizes, smartwatches must be small and unobtrusive in order to remain socially acceptable, which has long limited their practicality. The reduced size of the screen poses challenges to the possibilities and usability of multi-touch technology. One approach, followed by Google, is voice recognition. However, it does not appear to be socially acceptable to talk to a watch yet. In addition, in environments with strong noise pollution, its accuracy falls dramatically. This is particularly true of devices such as the Samsung Gear, as its microphones are tuned to support surrounding noise for its video recording feature.  
  
Devices such as the Moto 360 and Apple Watch make use of a gyroscope to recognize when users turn their wrist to look at the device so as to lighten up the watch face. This feature provides the foundations for a technology which emulates the most intuitive movements we do with our hands and arms - touching and pointing to something.   
  
The User Interface design below aims to enhance the most important capabilities of existing smartwatches while eliminating aspects and features that proved to be an impediment for usability purposes.

**Design**The watch designed, named The Watch, stays true to the timeless form of the classic wristwatch. A round design maximizes the display area and, unlike the Moto 360, effectively makes use of 100% of the screen.

In order to expand accesibility, two almost identical versions of The Watch accommodate both users that use their watch on their left arm (usually right-handed) and those who wear it on their right hand (frequentlly left-handed). The only difference between the two models is that the digital crown and fingerprint reader tip are exchanged -the digital crown is on the the same side of the watch as the hand that is free.  
  
Since wristwatches were invented in the 19th century, people have been glancing at them to check the time. With The Watch, this simple, reflexive act allows users to learn so much more. The Watch offers users the possibility to access scannable summaries of the information they seek out most frequently. These will very similar to the cards in the Context Stream: short snippets of relevant information, with an optional photo backdrop. Users will be able to swipe up to see expanded information.

To switch between cards, users simply swipe to the sides from the current screen. Users can tap on one of these cards to go directly to its corresponding app for more details. This makes navigation fluid and responsive.  
  
The Watch has a built-in ambient light sensor -alike the one found in the Moto 360. When it is enabled, the device adapts the light of the screen according to the environment the user is in, saving the user having to access the settings to increase or decrease the screen brightness whenever the lighting conditions change.

The Watch organizes users’ information by predicting what they need, when they need to see it and displaying it before they even ask. Users receive real-time notifications -in the form of a gentle tap- for incoming mail, messages, and calls. From the watch, they are able to decide whether to dissmiss them or answer them (either on a phone or on the watch itself). If the user decides to answer a text message on the phone, he will have three options. Firstly, he will be able to choose from a list of 4 or 5 text messages produced by the watch’s software based on the incoming message. For example, if the incoming message includes the words “What time...,” the sample messages will most likely be an array of times of the day. Secondly, if none of the custom messages offered by The Watch satisfies the user, he is able to select the option to answer by voice command, by tapping on the microphone that will be displayed on the screen. Lastly, the user is able to choose from a diverse group of emojis available.

In terms of user interaction, The Watch offers five (5) different ways for the user to interact with the device:  
  
1) Motion Recognition  
A 3-D gesture-recognition chip will be included inside The Watch that will enable it to recognize complex and precise hand motions and produce content accordingly. The chip uses sonar via an array of ultrasound trasducers --small acoustic resonators-- that send ultrasonic pulses outward in a hemisphere, echoing off any objects in their path. Those echoes come back to the trasducers, and the elapsed time is measured by a connected electronic chip. When using a two-dimensional array of transducers, the time measurements can be used to detect a range of hand gestures in three dimensions within a distance of about a meter.   
  
Specific examples of motion recognition include making and declining phone calls. When the user receives a call, he is able to decline the call by just shaking The Watch. The Watch will also offer Hands on Talk, the taechnoloy for bouncing sound waves off the user’s palm when making a call with the watch.   
  
2) Touch Screen  
In addition to recognizing touch, The Watch senses force, adding a new dimesniton to the user interface. The Force Touch technology, currently used by the Apple Watch, uses extremely small electrodes around the display to distinguish between a light tap and a deep press. This interaction triggers instant access to a range of contextually specific controls -such as an action menu in Messages, or a mode that allows the user to select different watch faces -- whenever the user wants.

Users can swipe downwards on the screen to cancel a selection or back one screen -when one screen away from the watchface pressing the digital crown and swiping down will have the same effect- and sideways to switch between applications.   
  
3) Voice Recognition  
The Watch’s Voice recognition will provide an accurate and reliable recognition that will allow the user to perform every single action the phone permits -except for authorizing payments- through voice commands. This attempts to provide full functionality to visually impaired users.   
  
Since The Watch will not include a video recording feature, the microphone will be configurated so as to isolated as much environment noise as possible.  
  
4) Digital Crown.   
This unique input device introduced by the Apple Watch offers phenomenal “out of the box” possibilities. On mechanical watches, the crown has historically been used to set the time and dat and to wind the mainspring. The Digital Crown allows users to zoom and scroll nimbly and precisely, without obstructing their view. Users can also push it like a button to return to the watch face, making it an integral part of the The Watch experience.   
  
5) Fingerprint Scanner  
One of the sides of The Watch has a built-in fingerprint reader tip, similar to those often found on Lenovo Laptops. This feature serves a single but crucial purpose: it allows users to verify their identity when making payments using the watch.

A significant flaw of present-day smartwatches is that when they run out of battery, users do not simply lose just the smart function. The display shuts down, and users lose the ability to even tell time. At this point, devices such as the Moto 360 become nothing more than an expensive bracelet. The Watch presents an innovative solution to this problem. Once the battery dies, the watch behaves like an automatic digital watch -the natural movement of the user’s arm provides enough energy to keep the watchface and display time accurately. Seiko, Citizen and more recently Ventura have manufactured several generations of automatic digital watches, and extending this technology to a smartwatch seems feasible.  
  
Finally, in terms of battery charging, The Watch will use a wireless charger employing inductive charging. This mechanism for charging was selected in order to maintain The Watch’s waterproofness.

**Usage Scenarios  
  
Office Use**

In office spaces, administrators interact both with each other and with various analog and digital devices in the offices, providing an interesting space to utilize smartwatches. The smartwatch’s interface could therefore not omit this kind of environments.  
  
As smart watches are normally worn on the wrist, there is a significant potential for them to digitally augment gestures performed in day-to-day contexts. The watch’s interface will include an application to assist office employees in easily locking and unlocking doors, in acquiring information and notifying others when they want to enter their office.

The reduced size of the screen calls for fast interactions. The Office app of the watch implements two types of physical gestures to support the most important functionalities. First the application provides the opportunity to perform a virtual knock with the same gesture as a real knock. Secondly, the interface supports opening/closing doors using the gesture of turning your wrist, just like turning a key to open a door.   
  
Knowledge workers tend to drop by each other’s offices regularly, for example, to ask for assistance or quickly discuss something. Even with the door open, knocking on the door is a common gesture to politely indicate your presence and check whether you are not interrupting the person. Using the smartwatch, one could digitally augment these gestures, which can provide a number of benefits. For example, when a person is not in his office, knock gestures could still be recognized and transferred to that person’s smartwatch. This allows office workers to keep a record of who came by and who they might have missed. Additionally, it is often inconvenient to interrupt a phone or Skype call to tell the person knocking on the door that it is not a good time. Nevertheless, depending on who is knocking on the door, it might be important enough to interrupt the phone call. Using the smartwatch’s interface, the person in the call gets a notification about the virtual knock, and can choose to grant or deny their colleague access, without having to interrupt the call.   
  
Keys (or keycards) are commonly used to open doors in office buildings. However, they present several disadvantages: generic keys could still provide access to restricted rooms; they might be lost or forgotten (e.g. employees could lock themselves out); employees might forget to lock their door, which could lead to theft of personal belongings or sensitive information. The smartwatch matches the identity of its users to the door they have the rights to open to prove more fine-grained access control. Using the user’s identity, employees can be restricted access only to doors they are allowed to open. Employees do not have to remember to bring their keys with them, assuming they always have their smartwatch on their wrist. To prevent theft, doors could be automatically locked after a specific period of time and door entry and exit could be logged.

When doing gestures, it is difficult to see what is happening on the screen. During the development of our app, we noticed that when a gesture was performed, the device could have detected two different gestures in sequence. However, when the user looked at the screen, he only got feedback of the last gesture that was performed. To address this problem, we decided to add audio feedback and play a sound every time a gesture has been detected. Users should be able to immediately distinguish the performed gesture based on the sound they hear. For example, when a virtual knock gesture is performed, the device plays a real knocking sound. For the opening/closing gesture we decided to use a rattling keys sound  
  
  
Audio feedback will also be generated when someone needs to be notified, like receiving a virtual knock on his device. This is helpful because users might not look on their watch at all times. Vibrations are only used sparingly, as they can be annoying to the user. Vibrations are only used for notifications: for notifying the user when someone is knocking on their door, when they need to attend a meeting, in case of an error, or when the user tries to perform an action without the

Right permissions (e.g. opening the boss’s office door).

**NFC**Near field communication, abbreviated NFC, is a form of contactless communication between devices such as smartphones or tablets. Contactless communication allows a user to wave the smartphone over a NFC compatible device to send information without needing to touch the devices together or go through multiple steps setting up a connection.  
  
With NFC, a new type of user interface emerges. It is not on the screen anymore, but deeply embedded in the real word. For smartphones, such technology was so far of limited success because it is convenient to control with the touchscreen. But for devices like a smart watch there will not be a screen of adequate size. Making contact with a NFC tag, which initiates a context-dependent action is the simplest thing to do, especially because the smartwatch is placed on the users’ wrist, and pointing to or touching something is one of the most intuitive human gestures to most groups. With NFC and smartwatches, this gesture has the potential to connect the real and the virtual world in a new and innovative way.   
  
Its NFC capability will allow users to share files, such as photos, videos, contacts, etc. by just having their phones in proximity.   
  
However, the potential uses of NFC go well beyond this. The NFC chip will let users purchase items just by reaching the phone close to a receiver at a cash register. In order to ensure the security of these transactions, each payment will require the user to swipe their finger through the fingerprint sensor, found on the side of the watch. This mechanism emulates the behavior of Apple Play on the iPhone 6 and iPhone 6 Plus.   
  
Users will also be able to use their rewards cards at different locations, or check in for their flights without the need to pull out their phones. The power will be   
  
  
Home Appliances  
Because of the small screen we wanted to make the interaction fast. We decided to implement three types of physical gestures to support the most important functionalities. First, we provide the opportunity to perform a virtual knock with the same gesture as a real knock. Secondly, we support opening/closing doors using the gesture of turning your wrist, just like turning a key to open a door. Finally, the last gesture we provide is swiping your arm to bring you back to the home screen with room scanning functionality.

**Rationale for Design**  
Smartwatches promise to bring enhanced convenience to common communication, creation and information retrieval tasks. Due to their prominent placement on the wrist, they must be small and otherwise unobtrusive, which limits the sophistication of interactions we can perform. This problem is particularly acute if the smartwatch relies on a touchscreen for input, as the display is small and our fingers are relatively large.

Principles of Good Wearable Design:

1. Glances, not stares: No smartwatch should ever command the attention, especially the eyesight, of a user for more than a few seconds at a time. Spending longer erodes any advantage over a smartphone

2. Interact once, display many times: Smartwatches should primarily provide displays of information and prompts for action rather than providing rich interactive elements, meaning they will show lots of information that is passively consumed.

3. Speed over accuracy: Consumer smartwatches should be flexible, fun, in-the-moment companions, which means they should make lots of ignorable suggestions rather than waiting to make a few suggestions that it deems perfectly right, as current predictive services do.

4. Pass the hallucination test: Smartwatch use can be perceived as novel behavior, but it can’t present like Bluetooth headsets, which make it impossible to know who is on the phone and who is screaming at an imaginary friend on the street.

The fashion-will-fix-smartwatches narrative is a really compelling story. It’s also completely wrong — or, at minimum, flies in the face of decades of study about how new technologies get adopted. As documented by Everett Rodgers in The Diffusion of Innovations, no fundamentally new product type succeeds solely based on the fact that it’s attractive; it succeeds because it does something genuinely useful at a price point low enough that people don’t consider it a luxury. And then it becomes normal and even attractive because it was first useful.

So if it’s not fashion, what is standing between today and the smartwatches-everywhere future? One thing: a great, unique interface that showcases how much better this new product type can perform both new and existing functions.

Eliminated some of the hardware at the table. Keep the online engagement to smaller bites and less intrusive manners.

Following requirements for navigation between screens on the watch:  
(i) a quick return to the watch face from any application,   
(ii) a time-out to the watch face from any function,

(iii) one touch deactivation of alarms,

(iv) direct access to the main list of applications,

(v) user programmable touch screen areas that could be used to access the user’s most important applications

(vi) the ability to easy return to the previous screen (People are familiar with the browser model and the concepts of following hyperlinks and going back in the browser history stack. Therefore extending the concept of a browser back button to every watch face screen is desirable)

We wanted usage of the wrist watch computer to be obvious, and avoid the need for a thick user manual for the watch. We started with Human Computer Interaction (HCI) concepts from familiar computing environments such as web browsers, etc., and then employed a user-centered design process to tune the environment.   
  
  
  
**Usability Metric Forecast**

References