Smartwatches. Data Streams. Security. Decision-Maker?

Smartwatches, a different type of accessory for the smartphone. Smartwatches are not your typical smartphone auxiliary add-on. Aside from the price being much larger than that of more common accessories like phone cases and headphones, a smartwatch is a computer connected to a paired smartphone. The question posed by this paper: Is the smartwatch just a gimmick? An over-priced toy? A spy's unfulfilled dream? Or is it much more than that? Can smartwatches have an influence on our daily lives?

First, let's think about an ancestor of the smartwatch, the fitness band. Fitness bands were used to track the user's movement in an attempt to measure the user's activity. The fitness band is getting a stream of data from the wearer. The data is generated from sensors in the band and then is quantified for the user and possibly stored in a database. For example, when attempting to track the number of steps taken, the fitness band uses the accelerometer and gyroscope to generate data. The data generated by these sensors is then analyzed to recognize what a step is and counts how many of these "step" events happened which can be used however desired and possibly stored in a database for later use. The important point here is that the fitness band is generating a new stream of data, in this case, the number of steps taken. This new type of data can then be collected and then analyzed by an algorithm. The algorithm can be used to only analyze the step data generated from one fitness band, which would result in data about that fitness band's user. The algorithm can also use step data from a multitude of fitness bands and calculate statistics on it, such as average steps taken. This is how users can compare their performance to past performances and even towards the performance of others.

Sensors, like the accelerometer, in smartwatches, are becoming more accurate leading to more accurate data which compounds to more accurate results. New sensors are being created

and added to smartwatches. New sensors mean new data streams. One of these new sensors is a heart rate monitor, these sensors continuously monitor the rate at which the heart beats. Users can use this sensor to help navigate towards the optimal heart rate when exercising. The same scenario with steps happens with heart rate, algorithms can analyze data from a single source or combine data from multiple sources. This can lead to insights into possible patterns in heart rate during certain activities without the need for an experimental setting.

One application of a smartwatch with a heart rate monitor is to be a medical device for those that need their heart rate to be monitored continuously. If this new data stream were to be collected and quantified, then, at a certain amount of data, the data can be analyzed by algorithms to find possible patterns. There is the possibility that smartwatches will be able to have sensors that monitor blood sugar and blood pressure. The blood sugar sensor would be able to continuously monitor the glucose levels in one's blood which would be incredibly helpful for diabetics in addition to generating data about glucose levels that could render very useful. There is still so much that humanity doesn't understand about the human body and possibly having a device, like a smartwatch, that can help gather data about the human body that can later be used to model the body can have great implications.

But what about outside of healthcare? That was the original question. How can smartwatches affect our daily lives? It was already mentioned that smartwatches generating data streams that are dependent on the individual. So these data streams are about a particular individual. If those data were then used for other uses, such as research, then the implications of its use could come back to affect the original individual. A feedback loop. Android Wear (the OS for android wearables) wearables have a GPS sensor built-in and a particular app called Speed Wear uses the GPS to turn your smartwatch into a speedometer. If the creators of Speed Wear

collected all the data generated from users of the app they could find out the speed at which people were going and where they were at the time. That data wouldn't be that useful since it would just show the speeds at which people would be running, hiking, biking, etc. since that is its main use. But if the app could somehow always track speed and location then that can be used to analyze traffic trends. Especially if the speed/location data points also came with a time stamp as well as the points being able to be compared to the actual speed limit of the road. To clarify, say that you are driving and your smartwatch notifies you that there is a traffic jam ahead of you. How could the smartwatch do this? The smartwatches of the people in front of you are sending data to servers with speed/location/time and an algorithm figures out that those people should be going around 40 mph but their actual speed is 15 mph. That data is then used to help notify other drivers incoming to avoid the area which not similar to how Google Maps does traffic notifications. A feedback loop. This data can be utilized by state governments to identify where there are possible bottle-neck areas of traffic and possibly be able to fix it: a continuation of the feedback loop.

Smartwatches are becoming more sophisticated in what they can monitor as well as generating more accurate data. If smartwatches become wide-spread enough to where the data generation is large enough, then there is a constant stream of data from a diverse group which can then be coupled with other data to find hidden problems or insights. For example, say a majority of the population had smartwatches that recorded their heart rates as well as their position using GPS and time, then there will be information about where heart rates are at a certain rate, at a certain time, at a certain location. The implications are numerous and implementations unknown. Questions of ethics and privacy are not addressed in this paper but are definite concerns for companies thinking about possibly using and generating this data.

Probably the greatest thing that smartwatches can do is creating these new data streams which can then be coupled with other pre-existing data. New data adds another piece to collective knowledge. Smartwatches being personal devices, they help guide understanding on the individual level.

Like mentioned before, smartwatches are starting to become outfitted with new sensors. In particular, sensors that measure the human body's metrics, biometrics. This was already previously mentioned with sensors that can measure blood pressure, blood sugar, and heart rate. There are biometrics that are unique to an individual, so instead of using something like a pin number or password you would use biometrics. This is biometric technology. Smartphones are an example that already uses biometric technology. Fingerprint readers are becoming a ubiquitous sensor on smartphones. These fingerprint readers allow smartphones take fingerprints as an input. The smartphone uses this new input data is security. A user uses her fingerprint, a biometric, to communicate to the smartphone that she has the authorization to access it. This verification is advantageous compared to using a password since fingerprints are very difficult to replicate as compared to a password.

How biometric technology applies to smartwatches is very similar. If smartwatches also become capable of gathering an individual's biometric data, then, instead of a single-time input like the fingerprint, there would be a constant flow of biometric data into the smartwatch, like heart rate. The heart rate then can become the owner's authorization code. Which can be further secured than the one-time authentication with a fingerprint. We can imagine that this form of authentication is very robust since one's heart rate pattern (ECG) remains constant independent of physical activity.

That is the next possible way that smartwatches can affect our daily lives. They can replace passwords. Smartwatches with accurate sensors can identify the user's unique biometrics. Whether that be a fingerprint, heart rate (ECG), gait (walking pattern), or a combination.

Since smartwatches will have a constant input of biometric data, which is unique to the individual, then the smartwatch will not only eliminate passwords but become the key to all other devices. Constant authorization biometric data confirms to the smartwatch that the correct person is attached to it so the question of whether or not an authorized user is truly using it will no longer be an issue. But why stop at just the smartwatch?

Smartphones have a feature that allows it to not require a passcode if a nearby trusted device is nearby. This typically is a reference to Bluetooth devices. If a smartphone is paired with a Bluetooth headset, then, after connection, the smartphone will no longer lock itself due to the "trusted" Bluetooth headset being nearby. One issue with this is that a Bluetooth headset can be stolen which can then be used to access the smartphone since many Bluetooth devices automatically connect with another paired device, like a smartphone. But what if instead of the trusted device being a Bluetooth headset it was a smartwatch that had constant authorizing biometric data? This would be much more secure since it would not be as simple as just stealing the smartwatch to gain access. Instead, the thief would also somehow be able to replicate the biometric data. And he would not only have to be able to replicate it once but continuously which would be near impossible. But why just stop at smartwatches?

The Internet of Things, where devices are connected to a network with which they can communicate with each other. One of the major concerns with the Internet of Things is a lack of security. One way to possibly alleviate this problem is to have a device only communicate with

another if the other device is trusted. No, I'm not talking about giving AI to a coffee machine. No. More along the lines of a "two-step" authentication. Much like how Bluetooth devices pair with other devices. We can have a what I would call a "central" device that would assure the other devices that they can continue to operate, like a boss except as device, not a human. That central device would be the smartwatch.

The smartwatch would become a proxy for the actual owner. So instead of requiring the owner to authenticate communication, the smartwatch would. The smartwatch essentially becomes the right-hand man (or I guess right-wrist man) for the human, choreographing all of the other connected devices to how the human desires. This would be secure because the smartwatch only gets this ability if the owner is physically wearing the device since that is the only way the smartwatch can obtain the authorizing biometric data. Almost anything and everything could become controlled automatically through the smartwatch. Walk up to your connected car, it starts and unlocks. Walk up to your house; doors unlock, lights turn on, or the coffee machine starts. A new type of organism emerges; a mechanical one that you influence which then adapts to you.

But could it be that the device could influence use? Could the smartwatch possibly condition an individual? In Psychology, the term Conditioning is the idea of learning to associate certain things with certain actions. The two types of conditioning are Classical Conditioning and Operant Conditioning. The way smartwatches could possibly influence an individual's decision making most closely corresponds to Operant Conditioning. Operant Conditioning uses reinforcement, like rewards, to increase desired behavior and punishment to diminish undesirable behavior. Now saying that smartwatches reward good behavior and punish bad behavior is a bit far-fetched. However, devices such as fitness bands can most definitely

influence decisions, albeit somewhat trivial decisions. For example, a fitness band can display that the individual is low on the number of steps taken. This can influence the individual to take the stairs instead of the elevator. So what if a device like a smartwatch could track how much sleep someone is getting and then notify the user? This could cause the user to either change her sleeping habit or go seek further advice. I like to term this idea as "Soft-Decision Making" since the smartwatch is actually making the decision for the individual but it does somewhat nudge the individual into a certain decision. As smartwatches become more advanced and are able to track more parameters then it's possible for them to have more influence in our lives.

So can smartwatches influence our daily lives? They most certainly can.

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