Paul M. Washburn
CSCI E-11 Unit 2: IoT
November 2, 2019

**Future Technology: Office Networking App – IoT**

Several technologies from the IoT unit could be combined in the development of an Office Networking App.  Unlike many industrial applications of IoT technologies – which are typically straightforward collections of data streams relevant to some production process – this use-case requires creative applications of IoT to help deliver value to professional users like Dr. Brown.

One application IoT is the use of networked microphones to collect a verbalized journal entry of each user that describes their professional interactions for the day.  This user-centric human-computer interface will enable the creation of data that can be mined for patterns by the Office Networking App.  A portion of these microphones could be networked from existing applications, such as a self-driving vehicle, so that users like Dr. Brown can either be commuting or in their office when they dictate their diary entry for the workday.  Dr. Brown's location when he records his dictated journal entry will determine how the data processing & transfer will take place.  When he is in a community self-driving vehicle, existing on-board microphones are powered by the vehicle's main computer system and thus will not have battery concerns.  Neither data volume-per-day nor device-to-gateway range will be a concern in this scenario since the vehicle can be used as a "data mule" and transmit Dr. Brown's data when connected to WiFi while it charges at night time.  Microphones will need to be installed in his office to allow for times when Dr. Brown is dictating his thoughts about his daily professional interactions when he is physically in the office.  By installing a few microphones in his office that are directly connected to power, Dr. Brown can choose whether to dictate his thoughts when he's in office or during his ride home – both of which are private environments.  If the entry is recorded in the office then the office WiFi can be used to transmit data to the cloud; otherwise the community self-driving vehicle will prompt a data dump when it is idle and connected to WiFi for the day.  Device-Cloud architecture is used here since there are no "real time" needs placed on the system, and thus no need for device-local or fog computing.

Indoor localization techniques combined with inexpensive indoor temperature sensors will be leveraged in this application to ensure Dr. Brown and his colleagues are never too-hot or too-cold in a meeting again – ensuring everyone is physically comfortable and ready to contribute.  Integrating each user's temperature preference data with meeting attendance data from the Virtual Assistant will inform the Local Warming technology which users are comfortable at which temperatures.  Users like Dr. Brown will be able to initialize their desired temperatures as a starting point, and over time the system will use wireless reflections of the human body to identify if a given individual has goosebumps (indicating they are cold at the current temperature setting) or if they are sweating (indicating they are hot at the current

temperature setting).  If a too-hot or too-cold flag is raised during a meeting, then at the end of the day the Office Networking App can ask Dr. Brown a quick *"Were you too hot/cold during your noon meeting today?"* to provide feedback into Dr. Brown's preferences.  By being cognizant of users' temperature preferences we can ensure that Dr. Brown and all of his professional colleagues using the application will always be physically comfortable during meetings.  The days of the freezing or sauna-like meeting rooms will be over.

The above indoor localization techniques could also be combined with camera data & wearable data to direct the lighting in a given meeting room at exhibitions focused upon by the speaker's inferred angle of gaze.  While highlighting the object of Dr. Brown's presentation, this system will also help Dr. Brown's audience take notes by shining lighting directly on their notebooks as they write.  When a given member of the audience is not taking notes, their lights will shut off to save on energy.

The microphones and cameras installed in meeting rooms will also be used to identify and surface "tense" interactions between colleagues, effectively identifying negative outliers in the productivity of a professional interaction.  This will be especially useful in large meetings where interactions between colleagues are rapid-fire and pass by quickly.  Voice recognition, speech to text, sentiment analysis, facial recognition & micro-expression classification (among other machine learning techniques) can be applied to the data collected in order to identify such "tense" interactions.  Furthermore, indoor localization techniques similar to those described above could also be used to measure breathing and heart rates to identify large jumps in heartrate and/or breath, thus augmenting the feature set.  Anomaly detection similar to what was discussed in lecture could be used to identify commonalities among outlier events.  Since this is an example of outlier detection, much of the raw data describing "non-tense" interactions will not be of much interest.  In the spirit of keeping only the data we need, raw data from neutral interactions will be discarded, keeping only the metadata and outputs of the summarization processes for these records.  For interactions that were sufficiently "tense," all of the raw data (e.g. audio/video, text translation) will be kept alongside the summarization process to allow for deeper analysis.  While hopefully the vast majority of interactions that Dr. Brown has with his professional colleagues are not "tense", this feature will be able to notify him when it occurs – and recommend some actions to help mitigate the damage & improve the relationship moving forward.

Finally, the existing cameras in both meeting rooms and common dining areas can be used to implement facial recognition combined with object detection to gather data on which colleagues enjoy which foods that are arrayed in the common area.  This will enable the collection of dietary preferences that users like Dr. Brown can employ when deciding where they'd like to take a colleague to lunch, or what sort of treat would maximally delight a given colleague.

There are few straightforward approaches to using IoT in an Office Networking App. By configuring a minimal IoT setup we are able to build value in the proposed Office Networking

App by improving the human-computer interface and by maintaining an optimal physical & emotional work environment.