COLLOQUIUM REPORT
"Point of Care and AgBio Diagnostics Smartphone Sensors." By Dr. Qingshan Wei.

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The talk introduced the point of care tests such as glucose monitoring test and pregnancy test. The point of care tests have to be affordable, low cost and many research is driven to achieve these goals. Past few decades, the research in these fields have been able to achieve the goals such as low cost by using smart technologies such as smartphone sensors. One major place that requires point of care testing is HIV testing where detection is very challenging. Here, currently the speaker is researching on usage of smartphone devices for detection. Since lot of people, nowadays use smartphone devices, the goal was to convert the smartphone devices into medical examination devices. The performance of smartphone sensors have improved significantly over time, which aids the medical examination. Comparison of high-end sensor and sensor of android phone was done, the results are quite similar, but the cost of smartphone sensor is quite cheap. By removing the lens module from the sensor of phone, one will be able to do holographic imaging. Various calculations of how to get high resolution images and nanometre size images were discussed. They were able to achieve single molecule detection which is every essential.

Comparison was between various smartphone cameras, where a monochrome camera which may work better than rgb camera. Through results it was shown that one could single-molecule detection using smartphone sensors. Next, research was done in field of detection of granular motion of nanometre particles where video based imaging was done. Another domain is the cancer mutation detection, for detection of cell or the mutant. Using the cell sample, detection can be done on whether there is breast cancer.

Another domain where smartphone sensors are used is the agriculture. Plant disease are a threat to global food security, hence detection of them is important. Current methods, such as visual inspection, antibody tests, cell culture, are sensitive and accurate but are complicated, slow and are costly. There is a requirement of rapid detection method in-order to stop spread of the disease. Here, micro needle for rapid DNA extraction is proposed. Using simple extraction procedure, one can extract DNA using micro needle. For detection, instead of sending the sample back to the lab, the micro needle can be integrated into smartphone diagnostic platform, for easy detection. This system was working very well, comparable to the benchmark detection. Also, speaker mentioned about multiplexed plant pathogen detection by smartphone where disease can be detected by smartphone sensors/images. Another application discussed was smartphone based plant-VOC sensor, where colour change is detected, and VOC sensor is used to detect various pathogens and plant diseases. Plant wearable sensors can be used for continuous VOC analysis, where nano sensors can be used to detect the pathogens. Next was discussion on mechanical cuts in plants

using sensors, using noise detection. The talk concluded with summary that smartphone devices can be converted to transformative microscopy devices with micron-level resolution, single-molecule sensitivity, millimetre to centimetre square field of view.

   In real-world smartphone sensors other than camera sensors are used for monitoring health-issues such as eye health, respiratory health, skin health, daily activity, ear health. Sensors such as motion sensors, position sensors, environment sensors can be used in this regard. Physical sensors that detect mechanical and thermal variables can be used to detect blood pressure, body temperature. The image sensor can be used to detect heart-rate, eye health, skin health, whereas the motion sensors can be used to detect daily activity, sleep, cognitive function and mental health. A smartphone microphone can be used as a sensor to detect ear health. These are some of the ways how the smartphone sensors can be used for human health apart from detecting human diseases as

discussed in talk. In the talk, we understand the cost of detection of major diseases such as AIDS, Cancer can be done in a very cost-effective manner using smartphone sensor rather traditional detection which costs a lot. This kind of detection would help detection of diseases among the poor and underprivileged and also would be helpful to people who don't have access to proper health care facilities. The main advantage of Point of Care Testing is that one can share the results instantly with patients. However, in general, core laboratory testing is more advanced, follows the process of laboratory testing and is paired with the technology required to ensure results are accurate, and properly validated, and are recorded before delivery. Also, the scope of the smartphone sensors is extended to agriculture where detection of plant pathogens and diseases were done. The traditional techniques for plant disease detection were considered as inadequate in stoppage of the large scale spread of diseases. Here, after research it was realised that the results got in these applications were very to comparable to traditional detection techniques. Also, other applications such as detection of mechanical cuts in plants were also discussed.