

List of Project Ideas Floated by Faculty**Project No. : ST-1**

Project Title	Portable pulse eddy current based rebar locator and corrosion inspection system
Faculty Mentor	Prof. Siddharth Tallur
Application	Structural health monitoring, corrosion assessment
Brief Description	Corrosion is a significant problem with huge economic impact due to failure of infrastructure and cost of repairs, that affects metallic structures such as pipelines, storage tanks, and also buildings constructed with reinforced cement concrete (RCC). In this project, the student team(s) will have to leverage ongoing work in Prof. Tallur's group to build a portable, handheld inspection tool (in a form factor similar to a barcode scanner) that can be used by structural engineers during structural audit and inspection to readily obtain the extent of corrosion of steel reinforcement bars (rebars) embedded in concrete. The system utilizes the principle of pulse eddy current, where magnetic field produced by eddy currents generated in the rebars due to an applied current pulse is used to assess the extent of corrosion.
Work expected	<ul style="list-style-type: none"> Improving analog front-end in existing design to increase signal resolution and reduce power consumption Designing digital backend for communication with user interface device (smartphone) and transduction of analog front end and sensor probe (coil + magnetic field sensor) Smartphone GUI for configuration, data acquisition and processing Building prototype system using 3D printers, laser cutter, power tools and other facilities available in experiential classroom in WEL
Reference, if any	Tamhane et al. <i>IEEE Sensors Journal</i> 21.19 (2021): 22086-22093. https://ieeexplore.ieee.org/document/9509426
Remarks/other comments	Only allowed for student group(s) that are present on campus and are able to work in the lab regularly.

Project No. : ST-2

Project Title	Wireless vibration sensing nodes for structural health monitoring
Faculty Mentor	Prof. Siddharth Tallur
Application	Structural health monitoring, vibration sensing
Brief Description	Vibration signals from structures instrumented with vibration sensors (accelerometers) can provide large amount of information on the state of health of the structure and can therefore be used for damage detection, classification, and progressive development. Such monitoring is suitable for systems whose structural behaviours are strongly influenced by their geometric complexity or material inhomogeneity. Given that this is typically non-invasive, such monitoring solutions can also easily be fitted on existing infrastructure such as bridges, several of which are multiple decades old and vulnerable to catastrophic damage.
Work expected	<ul style="list-style-type: none">• Design and implementation of wireless sensor node with vibration sensor• Testing on bridge mock-up/bolted frame and development of algorithms for predicting damage index
Reference	There are several papers available on vibration SHM of bridges. Interested students may look up some well-cited papers on Google Scholar. Here is an introductory, short read - https://www.structuremag.org/?p=18776 . Students may wish to develop something similar to STWIN kit, albeit low-cost and customized for vibration sensing application https://www.farnell.com/datasheets/3175699.pdf
Remarks, other comments	Only allowed for student group(s) that are present on campus and are able to work in the lab regularly.

Project No. : ST-3

Project Title	Battery-less water pollution monitor
Faculty Mentor	Prof. Siddharth Tallur
Application	Environmental sensing, water pollution monitoring
Brief Description	<p>The challenge presented to student teams interested in tackling this project is to develop an autonomous wireless sensor node, not requiring any batteries or power supplies to function in the field. Energy harvesting from NFC radios to power up an ultra-low power microcontroller has been shown to be feasible with newer microcontrollers from NXP, TI, Analog Devices and many other suppliers. The problem statement is to use such a system along with a suitable sensor to develop a system to monitor pollution of a water sample. The system should be powered up solely from a smartphone using NFC. The pollution level should be displayed on the smartphone screen. Students are free to use the sensing mechanism of their choice (pH, conductivity etc.) An NFC solution designed by us using STM components and few sensors are available with my group and will be made available to interested students.</p>
Work expected	<ul style="list-style-type: none">• Design and implementation of integrated wireless sensing node with NFC radio for water pollution monitoring• Data collection and analysis, algorithm development
Reference	https://www.st.com/en/nfc.html https://www.nxp.com/products/rfid-nfc/nfc-hf:MC_71110
Remarks, other comments	Only allowed for student group(s) that are present on campus and are able to work in the lab regularly.

Project No. : ST-4

Project Title	Environmental chamber for reliability testing of PCBs and components
Faculty Mentor	Prof. Siddharth Tallur
Application	Manufacturing of environmental chamber for laboratory use
Brief Description	https://www.iqsdirectory.com/articles/environmental-chamber.html
Work expected	<ul style="list-style-type: none">• Design and implementation of a prototype environmental chamber (students to choose temperature and humidity range)• GUI for instrument configuration and monitoring
Reference	https://www.iqsdirectory.com/articles/environmental-chamber.html
Remarks, other comments	Only allowed for student group(s) that are present on campus and are able to work in the lab regularly. Since this project has many components, <u>two teams may work together collaboratively</u> to complete it in one semester. Facilities such as 3D printers, laser cutter, power tools and other facilities available in experiential classroom in WEL may be utilized. The final product made by student teams will be kept in the experiential classroom for utilization by other students in future for reliability and stress testing of their projects.