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| **Mechanical Engineering Department** | |
| **B.E. Project proposal** | |
| **Name of the Guide** | Dr. Abhijit L Dandavate |
| **Title of the project** | Micro Drug delivery device for monitoring and real time insulin delivery for the diabetic person |
| **Domain of the project** | Design ( Product Design and Development) |
| **Type of the project** | Society/Industry/Any other |
| **Funding** | Self-financed/Industry sponsored/Institute sponsored/Any other |

**Problem statement**

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| The number of people with diabetes in India has increased from 26 million in 1990 to **65 million in 2016**. Diabetes Is a metabolic disease which prevents the body from regulating blood sugar levels, causing sugar level fluctuations. It requires systematic monitoring and control. Possible long-term effects include damage to large (macro-vascular) and small (microvascular) blood vessels, which can lead to heart attack, stroke, and problems with the kidneys, eyes, gums, feet and nerves. The project envisages to automate the blood monitoring and Insulin release regime so that patients can live a happy active life without worrying about their sugar levels. We plan to use non-invasive means to measure, monitor and record glucose levels and accordingly predict trends and induce dose at subcutaneous level using micro needles and an accurate drug delivery mechanism. Anomalies in food habits can thus also be tracked and warnings issued to the patient to keep him or her aware of consequences of their actions. A long term record of sugar fluctuations shall also enable clinicians to optimize the treatment regime. Using legacy data to dose response, smart adjustment of dose in future events can also be predicted and optimized. |

**Project description**

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| Objective/novelty/  Innovation | Enable diabetes management and control using non-invasive Blood glucose monitoring and delivery of micro doses of insulin to stabilize fluctuating sugar levels with human intervention or attention.  **Novelty** of our solution:   * Single wearable unit for monitoring and dose delivery * Plotting, analysis and pre-emptive algorithms for sugar management throughout the day * Cloud data storage and access system for monitoring * ‘Food Impact’ study feature to guide user on implications of food he or she intakes against its actual effect on sugar levels * Integration of Metabolic function with dose. * Anti-sepsis design * Data reporting to immediate family / doctor |
| Technology involved | WO2014158961A1 System and method for integration of insulin pumps and continuous glucose monitoring  US20100298765A1 Safety features for integrated insulin delivery system  US8460243B2 Glucose measuring module and insulin pump combination  EP 2 364 480 B1 substance monitoring and control in human or animal bodies |
| Overall approach/ architecture/design | **OVERALL APPROACH:**  Step 1 : Problem Discovery and Current State Of Art discovery  Step 2 : Concise to a workable User Requirement Sheet  Step 3: Conceptualisation, Architecture and Configuration studies to freeze System Specification  Step 4: Benchtop prototyping and Design optimisation  Step 5 : Final Sample prototyping and construction ( with IP consolidation)  Current high-level architecture (which may change after proper problem discovery) is shown below  This shall be detailed further in end of sem-1 based on discoveries done in mid of sem-1 |

**Semester-wise milestones:** (Please list out specific tasks that will be completed during semester)

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| **Mid of sem-1** | | **End of sem-1** | |
| Task to be  completed | Problem Discovery  Technology exploration  Determine freedom to operate | Task to be  completed | System level conceptualisation  Risk and Design FMEA  Architectural & config studies |
| Expected  results | User Requirement specification  Competition Benchmarking  Technology availability | Expected  results | System Requirement Specifications  Device Architecture  Subsystem shortlist |
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| **Mid of sem-2** | | **End of sem-2** | |
| Task to be  completed | Prototyping and testing  Optimisation of design  Reliability assessment | Task to be  completed | Final product design  Product integration in final shape  Development of integrated prototype |
| Expected  results | Benchtop Prototype  Frozen component list  Industrial Design of device | Expected  results | Demonstration Prototype  Early Trial report  IP consolidation |

**Expected deliverables/outcome:** Open-source code, design, architecture and technology assets, working prototypes, simulations, datasets, publications, intellectual property, etc.

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| User and System specification sheet, System architecture, Benchtop prototype results (both hardware and software), Final Demonstration prototype, Consolidated IP file. |

**Significance of the expected outcome with respect to the state-of-the-art in the field**

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| * Integration of metabolic function to dose adjustment * Long term data trends help in optimizing treatment methods * Plotting, analysis and pre-emptive algorithms for sugar management throughout the day * ‘Food Impact’ study feature to guide user on implications of food he or she intakes against its actual effect on sugar levels * Severe event notification through mobile * Integration of sugar level and metabolism function to determine correct dose levels * Integration with cloud * Anti Sepsis design. |

**Learning outcomes**

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| -Exposure to design thinking  -Surveying techniques and analysis  -Programming skills and algorithm  -Selection of various sensors and applications  -Prototyping  -Research aptitude  -Exposure to hardware-software interface  . |

**Relevant Industries /Applications**

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| -G.E  -Dassault system  -Philips  -PLCM |

**Relevance to the National/Global level competitions:** BE Project Topics can be aligned in various Competitions

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| **1. Sparkathon**  Link - https://www.cerebrospark.in/Sparkathon.html  **2. KPIT Sparkle**  Link - https://sparkle.kpit.com/i-innovate  **3. Quest Ingenium**  Link - https://www.questingenium.com/india/top-10-projects/  **4. Accenture Innovation Challenges**  Link - https://accenture-innovation-challenge-2021.hackerearth.com/challenges/hackathon/accenture-innovation-challenge-2021/custom-tab/top-10-teams/#Top%2010%20Teams  **Other Websites**  1. https://www.projectcontest.com/home/categories/events  2. https://www.knowafest.com/college-fests/competitions/Project  3.https://eventsget.com/events/type/technical-fests/past-events-india/page1/MTY=?cntry=MQ%3D%3D&orderby=2&srchtxt=&og%5B%5D=1&st=10101  4. https://saeindia.org/inter-college-project-competition/  5. https://circuitdigest.com/contest/india-automation-challenge-2021/#challenge1 |

**Prior relevant work/projects done by the faculty member**

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| Work is done for development of the literature and collecting information about different health parameters related to sugar management. |

**References**

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| 1. N. Schneeberger\*, R. Allendes, F. Bianchi, E. Chappel, C. Conan, S. Gamper, M. Schlund ” Drug Delivery Micropump with Built-In Monitoring” Science Direct Procedia Chemistry 1 (2009) 1339–1342 2. Hyunjae Lee etal, “Wearable/disposable sweat-based glucose monitoring device with multistage transdermal drug delivery module” SCIENCE ADVANCES 2017 3. Jiawei Zhao etal “In vivo monitoring of microneedle-based transdermal drug delivery of insulin” Journal of Innovative Optical Health Sciences Vol. 11, No. 5 (2018) 1850032 |

**Budget estimate**

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| **Sl No** | **Item** | **Justification** | **Total Budgets** |
| **A** | **Recurring** | | |
|  | Consumables | Cloud Charges, | 2000 |
| Travel | Traveling to Hospitals, Research Centres, | 2000 |
| Contingencies/Other costs | Paper Publication and Conferences | 1000 |
| **B** | **Non-Recurring** | | |
|  | Equipment | Node MCU, Ardiuno boards, Sugar Level Sensor, Oxygen level sensors, Temperature sensor, Blood Pressure Sensor, GPS | 10000 |
| Fabrication/prototyping costs | Assembling and Interfacing of Sensors with System | 10000 |
| **Total Budget (Recurring +  Non-Recurring)** | | Recurring+Non- Recurring | **25,000** |

**Sign of the Guide Project coordinator HOD**