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| **BSc (Hons) Computing Course 2023/24**  **Level 6 Production Project** | | |
| **Name: Soya Shrestha** | **Student I.D.: 77356846** | |
| **Course:** BSc (Hons) Computing | **Supervisor’s Name: Rohit Raj Panday** | |
| **Final Project Individual Aim & Objectives** | | |
| **Title of my Project:**  **Smart Vitals: A portable Health Monitoring System** | | |
| **Aim of my Project:**  **To design and develop a portable health monitoring system that accurately measures users’ vital health indicators in real-time, allowing for timely medical interventions when needed.** | | |
| **Objectives of my Project:**   1. **Study the application of IoT in health care.** 2. **Develop a basic understanding how portable health devices are revolutionizing health management through real-time health monitoring.** 3. **Explore algorithms for detecting real time health vitals.** 4. **Gain in-depth knowledge of C/C++ programming in embedded systems and integrate these programs with sensors in a portable device to monitor heart rate, SpO₂, blood pressure, ECG and body temperature via OLED display for local access.** 5. **Design and develop a mobile application which will help the registered family member in monitoring the vital signs of the user in real-time.** 6. **Integrate a notification system in the mobile application to alert registered family members or caregivers any time the device detects any abnormal readings.** 7. **Additionally, the OLED display features a graphical interface where required to give a clear visualization of vital health measures.** 8. **The product will include a physical button allowing users to measure specific health vitals as needed.** 9. **Custom PCB design ensuring all the hardware components are integrated efficiently.** 10. **Design a 3D printed structure to ensure products’ durability and portability.** | | |
| **Specification of my Product:**  **Functional and Non-Functional activities with MoSCoW:**   |  |  | | --- | --- | | **Functional Requirement** | **MoSCow** | | Device must be portable, lightweight and user-friendly. | **M** | | The device must be connected to Wi-Fi for seamless interaction. | **M** | | Must be able to measure heart rate, SpO₂, blood pressure and body temperature. | **M** | | Must be able to get real-time health measurement through OLED display for quick and local access. | **M** | | Should be able to get access to the health readings via mobile application. | **S** | | Should send family member or care giver notification if any irregularity in health reading via email. | **S** | | Voice alert via mobile application for any irregularities in the readings. | **S** | | The mobile application could be able to get knowledge on air quality and room temperature. | **C** | | Users would get insights on the location of the device. | **W** |  |  |  | | --- | --- | | **Non-Functional Requirement** | **MoSCow** | | Smart Vitals must be convenient, compact and easy-to-use. | **M** | | The OLED must display the measurements on the spot. | **M** | | The mobile app must show all the readings with necessary charts. | **M** | | The battery on the device should operate for at least a day or 2 days. | **S** | | The device could support additional sensors for future works. | **C** | | | |
| **Research:**  One of the most researched areas in medical science is the application of IOT-based health monitoring system (Shaown, et al., 2019). Personal Healthcare Devices (PHD) are portable healthcare devices that measures user's vital signals. Using IoT devices for health monitoring systems has become an essential part for remote healthcare as it is user friendly, lightweight and cost effective (Woo, et al., 2018). The system uses embedded technology and different sensors to gather real-time data of user including, ECG, body temperature, SpO₂, and Blood Pressure and shows the readings on the OLED display or is transmitted over Wi-Fi to a mobile application(Raja, et al., 2024)**.** The end goal is to provide users with a cost effective and reliable healthcare device. By providing real-time insights of vital signs this system allows for timely interventions when necessary (Abdulmalek , et al., 2022).  **Evaluation:**  To successfully complete the project, it is essential to meet all the objectives mentioned. For that extensive tests are conducted. Wide range of data will be fed to the device. Resulting output will determine accuracy of the system.  To ensure that all functionality of the system, such as accurate reading of heartbeats, blood pressure, body temperature and oxygen levels and sending real time notification, are met continuous testing will be done. It includes providing a variety of health conditions and sensor inputs to check how the system performs under different scenarios. Depending on the accuracy and precision of the readings, reliability of the system will be determined. A detailed evaluation of hardware and software components will be conducted to determine how well the components work together. | | |
| **Project Planning & Methodology** | | |
| **Project Planning:**      **Fig 1: Task sheet of the project**        **Fig 2: Gnatt Chart of the project**    **Fig 3: Timeline of the project**  **Methodology:**  SpO₂ sensors, EGC sensors, temperature sensors, and Arduino board, were selected based on their performance and precision (Michaluk, 2021). The sensors were embedded in Arduino and evaluated for different measurements, for real-time access including OLED display with graphics.  Real time health readings were provided to the caregivers through a flutter-based mobile application whenever any irregularities are detected. It also provides data security through an encrypted communication system ensuring the users' privacy(Giesbrecht, 2022). The sensors’ reliability and precision would be validated by contrasting the readings with the medical devices. The project would implement Agile methodology, by dividing the development process into iterative phases, focusing on particular milestones, including sensor configuration and mobile app development. In order to track the progress, Gnatt chart and Timeline would be used. | | |
| **Resources** | | |
| **The hardware and software I require to complete my Project successfully:**  **Hardware:**   1. **Laptop** 2. **Esp32 Wrover type B** 3. **MAX30102 sensor** 4. **ECG Sensor (AD8232)** 5. **3D printed box** 6. **Temperature Sensor** 7. **Matrix Board** 8. **Male / Female Header** 9. **Jumper wire** 10. **OLED Display** 11. **Push Button** 12. **Reset Button** 13. **DHT22** 14. **MQ-135** 15. **GPS Module** 16. **Data Cable Type B** 17. **Power bank Module** 18. **Lithium-ion battery**   **Software:**   1. **Programming Language (C / C++)** 2. **Code Editor / IDE (VS Code, Arduino IDE)** 3. **Operating System (Windows)** 4. **Flutter** 5. **Dart** 6. **Microsoft Word** 7. **Microsoft Project** 8. **Microsoft Powerpoint** 9. **GitHub** 10. **Firebase** 11. **TinkerCAD** | | |
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| **Human Resource** | | |
| **I am working on my Project with the following people** | | |
| **Name: Soya Shrestha** | **Role:**  Module Leader: Rohit Raj Pandey  Supervisor: Rohit Raj Pandey | |
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| **Initial Bibliography**  Abdulmalek , S. et al., 2022. IoT-Based Healthcare-Monitoring System towards Improving Quality of Life: A Review. *Healthcare ,* 10(10).  Giesbrecht, H., 2022. *StarFishMedical.* [Online]  Available at: https://starfishmedical.com/resource/6-tips-implementing-agile-medical-device-development/ [Accessed 5 January 2025].  Michaluk, W., 2021. *htdhealth.* [Online]  Available at: https://htdhealth.com/insights/medical-device-software-development-waterfall-or-agile/ [Accessed 5 January 2025].  Raja, G. B. et al., 2024. Portable IoT Smart Devices in Healthcare and Remote Health Monitoring. In: H. Murthy, M. Zurek-Mortka, V. . J. Pillai & K. P. Kumar, eds. *Internet of Things in Bioelectronics: Emerging Technologies and Applications.* Beverly: Scrivener Publishing LLC, pp. 125-143.  Shaown, T., Hasan, I., Mim, M. R. & Hossain, M. S., 2019. *IoT-based Portable ECG Monitoring System for Smart Healthcare.* Dhaka, IEEE, pp. 1-5.  Siam, A. . I. et al., 2023. Portable and Real-Time IoT-Based Healthcare Monitoring System for Daily Medical Applications. *IEEE Transactions on Computational Social Systems,* Volume 10, pp. 1629-1641.  Woo, M. W., Lee, J. W. & Park, K. H., 2018. A reliable IoT system for Personal Healthcare Devices. *Future Generation Computer Systems,* Volume 78, pp. 626-640. | | |
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