Project Brief-ENG20009

Name: H M ASFAQ AHMED
SHIHAB
Major: *Software*
Instituion: Swinburne University
of Technology
Address: Box Hill, Australia.
Email:
103849248@student.swin.edu.au

INTRODUCTION

This report provides a thorough summary of the project undertaken as part of the Engineering Technology Enquiry Project (ENG-20009). The goal of this course is to provide students with the skills and information needed to confront and solve engineering technology difficulties. Thermo Fisher Scientific Australia Pty Ltd, a major provider of scientific apparatus, reagents, consumables, and software services, is one of our industry partners. This unit also enables students in hand experience with a complex open-source electronic platform which is Arduino. The aim of the unit is to establish a deep understanding of software and hardware.

As per unit requirements the team needs to select at least two of the sensors provided. I have selected the Temperature, Humidity, Pressure and Gas sensor because of its flexibility and multiple useability. As a software engineer working with such a complex sensor can provide real-world skills. The THG sensor is a popular and flexible sensor that combines temperature, humidity, pressure, and gas detecting capabilities in a single device. This sensor is significant because it provides real-time monitoring of numerous environmental factors, which is vital for a variety of applications ranging from indoor air quality monitoring and weather forecasting to industrial process management and smart home automation. A software engineer can develop range of functions such as Indoor air quality monitoring, Whether forecasting, HVAC control, Agricultural monitoring, and smart home monitoring. Due to these reasons, I have selected the Temperature, Humidity, Gas sensor.

PROJECT OVERVIEW

Our group of five students were assigned to develop a SDI-12 sensor and data logger as per the of this unit requirement. The project will undergo several stages, including planning, design, building, programming, testing, and debugging. Our solution was developed to communicate with several types of sensors via the most common communication protocol, SDI12. Each of the team members has been assigned with different tasks which includes programming, testing the hardware, designing, and building the overall project

SENSORS AND APPLICATIONS

The SDI12 sensor and interface that will be used in this project was demonstrated in the seminars and laboratories. It also incorporates sensor computer testing. Each group will be required to choose at least two sensors, which were then connected to an Arduino microcontroller via the I2C or UART interface. The data from the sensors was collected and transferred to the UART interface using the SDI command capabilities. More specifically, the sensor (I2C) is linked to a UART converter, which is then linked to an SDI-12 USB converter, which is then linked to a computer. The computer executes all commands.

Sensors:

Temperature, Humidity, Pressure and Gas Sensor:

The Temperature, Humidity, Pressure and Gas sensor (BME680) is a multipurpose environmental sensor that can monitor temperature, humidity, pressure, and gas. It's widely utilised in a variety of applications, including weather monitoring, interior air quality monitoring, and personal health monitoring.

The BME680 sensor (Bosch developed this specific sensor) measures these parameters using MEMS (micro-electromechanical system) technology. It features an in-built heater that allows it to precisely measure VOC (volatile organic compounds) in the air. The sensor can communicate with microcontrollers and other devices via I2C and SPI interfaces. The Temperature, Humidity, Pressure and Gas sensor is a good choice for applications requiring accurate monitoring of a variety of environmental parameters.

Digital Light intensity Sensor:

The Digital Light intensity Sensor (BH1750FVI) is a digital ambient light sensor that detects light intensity precisely. It communicates with microcontrollers via a digital output and an I2C interface, and it has an ADC for excellent precision and resolution. The sensor has a large dynamic range for monitoring light intensities ranging from low to high. It's widely used in smart lighting, automated brightness adjustment, and light metres since it's simple to use, compact, and low-power, making it ideal for portable and battery-powered devices.

GPS Module:

The GPS module (U-blox NEO-6M GPS Module) is a small and precise GPS receiver that is utilised in a variety of

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applications to provide position and time information. It contains a high-sensitivity receiver and an integrated antenna, can track up to 22 GPS satellites, and supports NMEA, UBX, and RTCM communication protocols. The module has a backup battery, operates on low power, and communicates through serial interface. It is appropriate for battery-powered and portable devices that require accurate and dependable GPS data.

IV. Literature Review:

A literature review is a comprehensive study or evaluation of existing research and scholarship on a particular topic. It involves discovering and studying relevant sources, such as books, journals, and other publications, to get a thorough grasp of the current state of knowledge and to find gaps, contradictions, and unsolved issues. It can also serve as a foundation for further research and possibly developing new solution.

This literature review will focus on the existing research and journals on the success, applications and knowledge gap of Temperature, Humidity, Pressure and Gas Sensor (BME680). The aim is to give a critical evaluation of the study and research on these sensor as well as finding possible knowledge gap.

1. **Y. -L. Hsu, H. -L. Tsai and G. -H. Lu, "Development of Wireless Multi-Sensor Module for Monitoring Environment of Smart Manufacturing Workplace,"** describes the development of a wireless multi-sensor module for monitoring the environment in a smart manufacturing environment. The module is intended to gather data on various environmental characteristics such as temperature, humidity, noise, and vibration and to wirelessly transfer this data to a central monitoring system.

   The article illustrates the module's hardware and software components, which are meant to be tiny, low-power, and simple to install. It also shows the outcomes of testing the module in a simulated smart manufacturing environment, demonstrating that it can give precise and reliable measurements of environmental factors.

   The absence of discussion on the possible limits and problems of deploying multi-sensor modules for environmental monitoring in a smart manufacturing scenario is one knowledge gap in the research. The authors, for example, do not address sensor accuracy and reliability, calibration and maintenance, or data security and privacy.[1]

2. **Jithina Jose and** T. Sasipraba's research paper "**Indoor air quality monitors using THG sensors and LPWAN**" describes the creation and deployment of an indoor air quality monitoring system based on Internet of Things (IoT) sensors and Low-Power Wide-Area Network (LPWAN) technologies. The system's purpose is to offer continuous and real-time monitoring of indoor air quality indicators such as temperature, humidity, carbon dioxide, and particle matter. The article defines **THG sensor** and LPWAN and explains their benefits in the context of indoor air quality monitoring.

   FINALLY, THE ARTICLE EMPHASISES THE ABILITY OF SENSORS AND LPWAN TECHNOLOGIES TO IMPROVE INDOOR AIR QUALITY MONITORING AND MANAGEMENT.

   *THE LACK OF DISCUSSION ABOUT THE POTENTIAL LIMITATIONS AND CHALLENGES OF USING TEMPERATURE, HUMIDITY, AND GAS SENSOR AND LPWAN TECHNOLOGY FOR INDOOR AIR QUALITY MONITORING, SUCH AS SENSOR ACCURACY AND RELIABILITY, DATA PRIVACY AND SECURITY, AND THE NEED FOR CALIBRATION AND MAINTENANCE, MAY BE A KNOWLEDGE GAP IN THE PAPER.**[2]***

3. *JING GAO, JINMING LUO, AORAN XU, JIA YU'S* ***RESEARCH ARTICLE "LIGHT INTENSITY INTELLIGENT CONTROL SYSTEM RESEARCH AND DESIGN BASED ON AUTOMOBILE SUN VISOR OF BH1750"*** *DEPICTS THE DESIGN OF AN INTELLIGENT LIGHT INTENSITY SENSOR BASED ON BH1750 WHICH WILL BE INSTALLED IN AUTOMOBILE SUN VISORS. THE AIM IS TO AUTOMATICALLY ADJUST THE BRIGHTNESS OF THE SENSORS DEPENDING ON THE LIGHTING CONDITION AND PROVIDE OPTIMAL VISIBILITY AS WELL AS REDUCING GLARE. THE ARTICLE ALSO PROVIDES THE RESULT SUCCESSFULLY TESTING THE PROTOTYPE AND ACCURATELY CHANGING THE BRIGHTNESS DEPENDING ON LIGHTING CONDITION. IN ADDITION, IT DESCRIBES THE HARDWARE AND SOFTWARE COMPONENTS USED FOR THE RESEARCH.*

   *THE ARTICLE LACKS ON DISCUSSION SUCH AS ENVIRONMENTAL IMPACTS SUCH AS TEMPERATURE AND HUMIDITY. THERE IS NO DESCRIPTION OF HOW SUSTAINABLE THE PROJECT WILL BE AND THERE WERE NO COMPARISONS WITH OTHER SENSORS.**[3]***

V.PLANNING AND TASK DIVISION:

As a group it is essential to draft a plan and divide the task between each team members. First two weeks we focused on team building. All team members of Group-4 were present in most of the group discussions. In the group discussions each team member was assigned with different task. The group divided the tasks from the modules. Below is a list of the planning for the project,

A. Task Planning:

   1. Week-1:
      - Team forming and allocating roles.
      - Learning and developing coding skills for Arduino.
      - Conception of SDI-12 sensor
   2. Week-2:

- Proposal of the initial circuit design.
- Research on real-world sensor applications.
- Investigate coding and circuit alternatives for connecting sensors as needed.

3. Week-3:
    - Complying code to accompany the circuit design.
    - Selection of the sensors and choosing design.
4. Week-4:
    - Constriction of a draft circuit for final submission.
    - Developing a draft code for the final submission.
5. Week-5:
    - Debugging
    - Checking the codes and circuit as per submission requirement.
6. Week-(6-10):
    - Debugging (continuation from earlier weeks).
    - Final design and program.
7. Week-(11-12)
    - Final demonstration

B. Task Division:

1. Shihab: Team co-ordinator and will allocate roles between the team members. Code and circuit evaluation for final submission.
2. Sadman: Literature search for real-time use of the sensors, Debugging.
3. Jack: Programming the code for the final submission and debugging.
4. Rexy: Wiring the circuits as per design, testing and debugging the code if necessary.
5. Ibnul: Explore coding and wiring options for the circuit as per unit requirement.
6. All team members: Basic understanding of for Arduino, developing necessary coding skills, participating in circuit design, Finalising the code and design for the final submission, and participating in the final submission.

Distention and High Distention task requirements will be done by the whole team. Applying interrupt service routine to program the SDI-12 sensor above and Applying event-driven programming using interrupt and advanced interrupt-driven programming will be a team effort, the team is planning on doing these tasks during our personal team meeting where every member will be actively involved in coding, designing, and wiring the circuit respectively.

VI. Conclusion:

Finally, group four is deeply invested in the project and is completely committed to understanding the design specifications and project implementation. The team members were assigned roles and actively participated in discussions and design decisions (each team member was assigned with coding specific parts of the program and design). Our group has carefully selected each of the sensors and their applications to correspond with our major. The team feels that completing this project successfully will offer us with valuable experience and knowledge in engineering technologies that will be beneficial in future jobs.

References

[1] Y. -L. Hsu, H. -L. Tsai and G. -H. Lu, "Development of Wireless Multi-Sensor Module for Monitoring Environment of Smart Manufacturing Workplace," 2022 61st Annual Conference of the Society of Instrument and Control Engineers (SICE), Kumamoto, Japan, 2022, pp. 797-802, doi: 10.23919/SICE56594.2022.9905821.

[2] J. Jose and T. Sasipraba, "Indoor air quality monitors using IOT sensors and LPWAN," 2019 3rd International Conference on Trends in Electronics and Informatics (ICOEI), Tirunelveli, India, 2019, pp. 633-637, doi: 10.1109/ICOEI.2019.8862647.

[3] J. Gao, J. Luo, A. Xu and J. Yu, "Light intensity intelligent control system research and design based on automobile sun visor of BH1750," 2017 29th Chinese Control And Decision Conference (CCDC), Chongqing, China, 2017, pp. 3957-3960, doi: 10.1109/CCDC.2017.7979192.