BSc (Hons) Computing Course 2020/21

Level 6 Production Project

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Course: BSc (Hons) Computing	**Supervisor's Name:** Saroj Shakya

Final Project Individual Aim & Objectives

Title of my Project: IoT based cyber-physical automation: Strategic cost reduction and deployment in Nepal

Aim of my Project: This project aims towards an approach to develop and implement a low-cost, energy efficient IoT based cyber-physical automation system in Nepal. The goal of this project is to design and deploy a prototype as a proof of concept that is inexpensive yet competitive with other IoT products in terms of energy efficiency, cost and security.

Objectives of my Project:

The main objective behind this project is discussed as follows:

- Compare technology and apply cost reduction strategies for choice of IoT development board.
- Apply method to make the prototype energy efficient.
- Design an inexpensive prototype that is competitive with other IoT products in market with similar features.
- Integrate security measures to mitigate software and hardware vulnerabilities in the prototype.
- Build the product upon successful test and evaluation of the prototype.

Specification of my Product:

Functional Requirements — Part A: Control Specification

Requirement ID	Description	MoSCoW
A1	**An interface to allow users active interaction with IoT server.**	

A1-1	Users will be able to login/logout to their dashboard.	M
A1-2	Users will be able to perform CRUD operation (Create, Read, Update, Delete) based on status of their GPIO (General Pin Input/Output) for digital devices.	M
A2	**An interface to allow users to match their ergonomics.**	
A2-1	Users will be able to schedule uptime of their appliances.	S
A2-2	Users will be able to pick a dynamic range of RGB (Red, Green, Blue) channeled colours as per their need for lighting purpose.	S
A3	**An interface to allow users active surveillance and security.**	
A3-1	Users will be emailed a potential fire hazard caused by inflammable gas leakage.	C
A3-2	Users will be able to stream a real-time surveillance video on their dashboard.	W
A3-3	Users will be able to receive a burglary email notification with attached photo on motion detection.	C

Nonfunctional Requirements — Part B: Configurability Specification

B1	**An interface to allow controlled devices extensibility and scalability.**	
B1-1	Users will be able to translate and map digital and analog values to control integrated electromechanical devices.	M
B1-2	Users will be able to control higher electrical loads.	S
B1-3	Users will be able to view and interact with real-time sensor data collected from an array of sensors including temperature, humidity, light, pressure and altitude sensors.	M
B1-4	Users will be able to set device status based on sensor threshold value.	S

Research: If I were to book a hotel, it would know my estimated time of arrival because the booking app in my phone would know my current location. The hotel would know if I were sweaty and tired because it has access to the data in my fitness gear, it would automatically enable air conditioning and cool the room before my arrival. The advancement in IoT (Internet of Things) began around 2008 AD. IoT is known as a network of connected devices that are embedded with sensors and can relay information to other devices over the internet. IoT has been one the most rapidly evolving technology. IoT could help solve global challenges in various paradigms like health, climate change, energy shortage and rapid urbanization. (Hinkle, 2019). With the help of this project, I would like to put light on these paradigms and evaluate myself how implementation of IoT would help save energy and resource cost.

Evaluation: Evaluation of the prototype concept will be based upon product specification and requirements, but evaluation of final product will be based upon usability factor, unit tests, suggestions, white-box testing and black-box testing approaches. Unit tests will be conducted under hardware abstraction layer without actually accessing the hardware directly. To design a good architecture of a system and for a proper testing and evaluation, a combination of these factors plays an important role altogether. A relevant evaluation of prototype will be carried out by taking input from prototype reviewing participants who will be suggesting critical improvements on the product.

Project Planning & Methodology

Project Planning: After gathering substantial resources and researching, the prototype will be built on the basis of a suitable IoT development board. An array of sensors, actuators and microcontrollers will be brought to use to architect a fully reliable IoT based cyber physical automation system. After the successful development of the product, a feasibility analysis and case scenario for product deployment in Nepal will be studied.

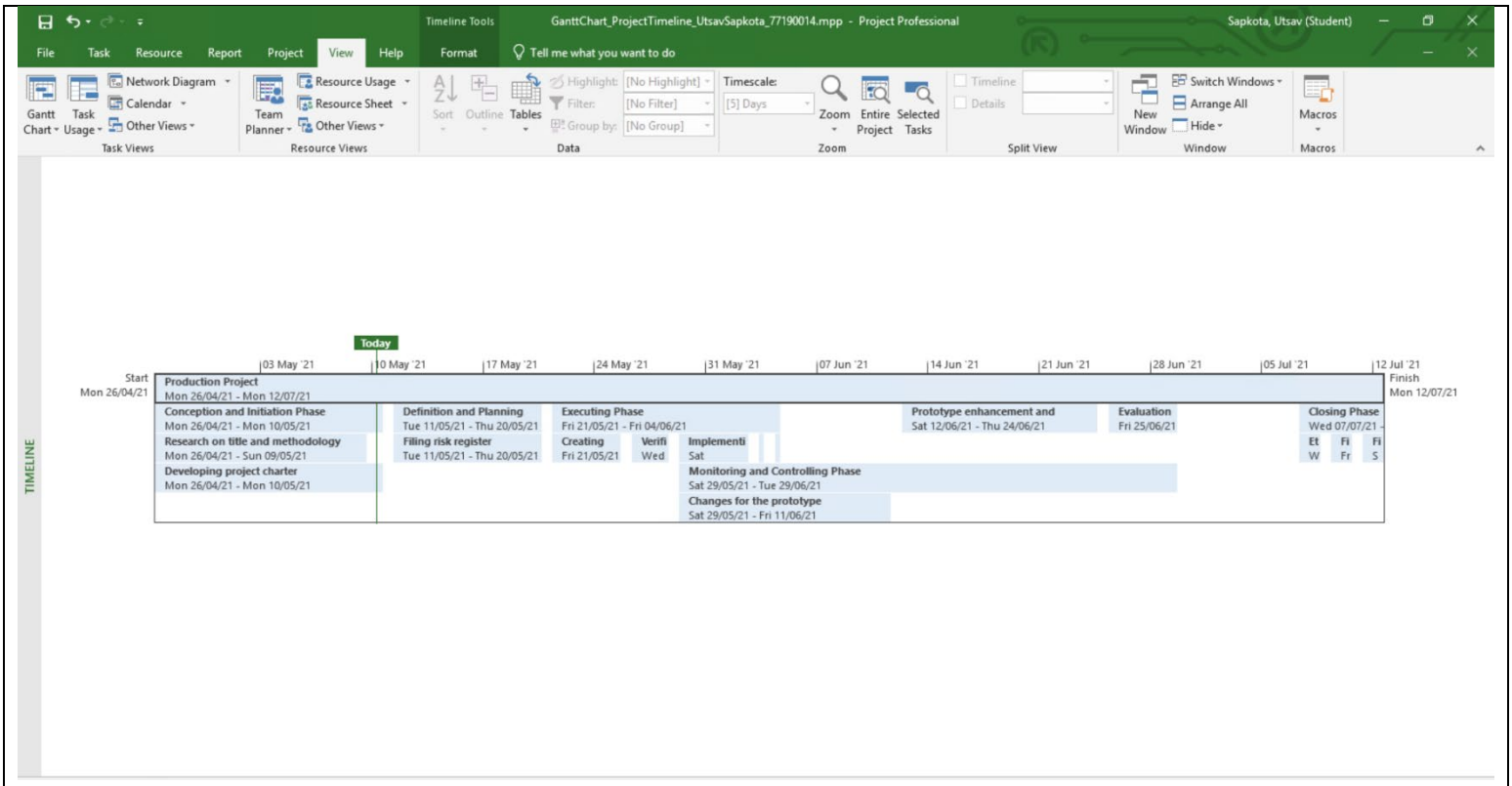

Figure 1 Project Timeline

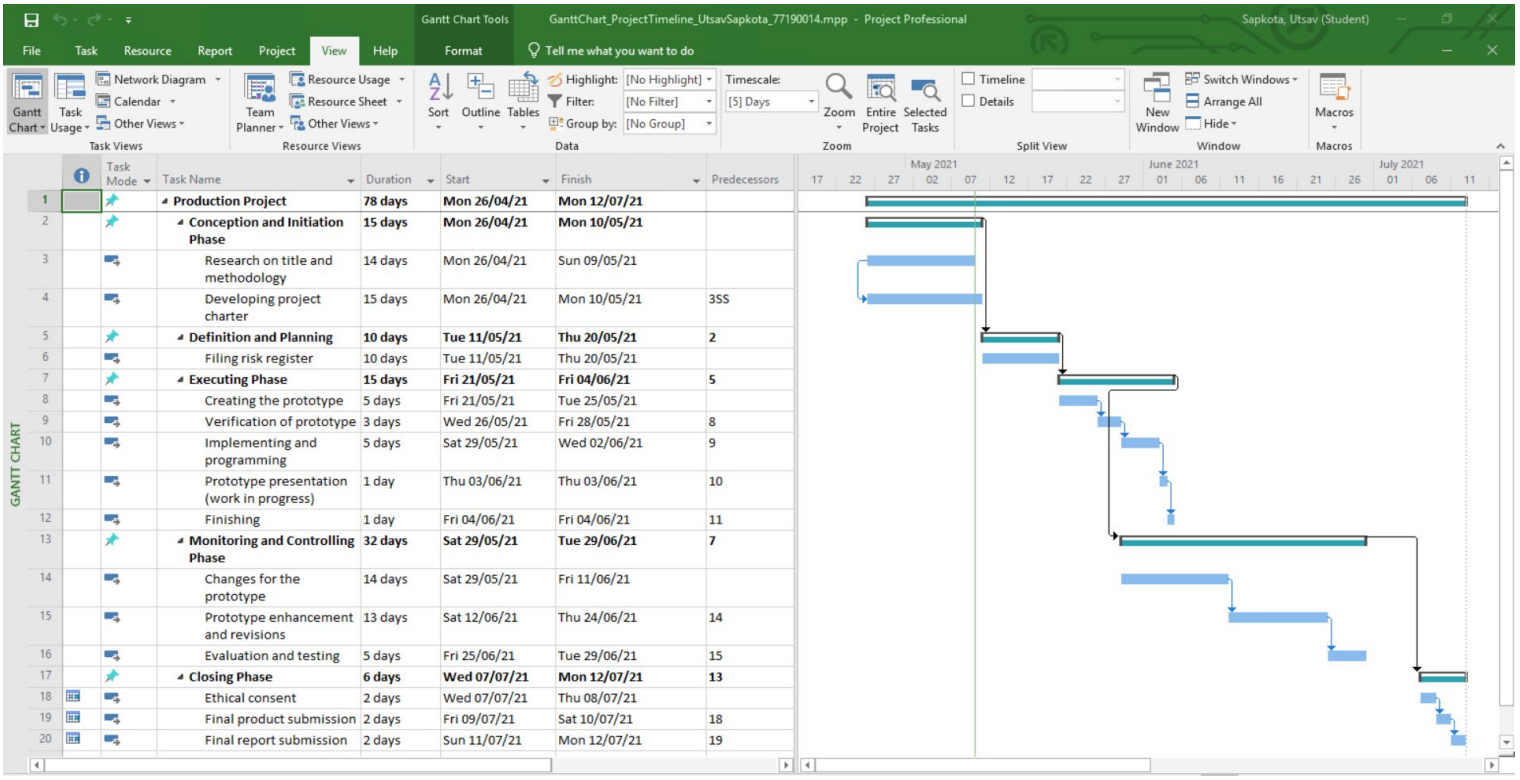

Figure 2 Gantt Chart

Methodology: For the purpose of this project, prototype model will be adopted since the end product is not known. A prototype will be built by assembling electronic devices on a breadboard (protoboard). Multiple trial phases of programming tests and circuitry changes will be conducted. The prototype will be tested and improved with feedback over multiple cycles until a fully functional prototype is built with all elicited specifications. Hence, the final prototype will be assembled for product development with electronic components soldered on a matrix board or on a printed circuit board.

Motivation for choosing prototype model:

- It is suitable for high-risk projects.
- The complexity of error in final product is low as prototype is continuously tested and improved from early stages.
- It is flexible to implement suggestions, ideas and revisions.
- Prototyping is best suited when feasibility of the product is unknown at early stages of development.

Resources

The hardware and software I require to complete my Project successfully:

Hardware requirements: 3D-printed miniature house, personal computer, ESP32-CAM module, FTDI programmer module, passive infrared motion sensor, MQ-2 gas/smoke sensor, photo resistor, DHT 22 module, BMP180 pressure sensor, RGB light strip, laser diode, brushless motor, buzzer, jumper cables, SG90 servo motor, resistor pack, general purpose NPN transistor pack, LED light pack, matrix board, soldering iron, soldering wax, solder, protoboard, DC jack, 9V battery, 9V adapter, 6V relay module, soldering stand, soldering safety equipment, PCB drill, multimeter.

Software requirements: Arduino IDE, ESP32 Arduino core library, Espressif IoT Library, Visual Studio Code, Fritzing, Microsoft Office 365 package.

Human Resource

I am working on my Project with the following people

Name:	**Role:**
	Module Leader
	Supervisor

Initial Bibliography

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