DESIGN AND IMPLEMENTATION OF AN AUTOMATED BAG VALVE MASK-BASED RESUSCITATOR

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Outline

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Introduction and Background

Figure 1: Manual BVM resuscitation

In Uganda, there are three primary models for supplying oxygen: cylinder-based systems, oxygen concentrators, and oxygen generators/plants, with concentrators being the most used. There are currently 17 medical oxygen plants[1].

Bag Valve Mask (BVM), which is made of Polyvinyl Chloride (PVC) Material, has been utilized as an emergency manual ventilator in which a bag is pressed to deliver oxygen to patients.

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Problem Statement

The current reliance on manual operation of manual Bag Valve Mask(BVM) Resuscitators pose challenges in providing continuous and reliable ventilation to patients. The limited number of physicians further strains the manual usability of the BVM bags as they require continuous pressing to reliably deliver oxygen to patients. Human error, fatigue, inconsistency, and the need for uninterrupted care highlight the necessity for an automated system that can perform this life-saving task with a high degree of reliability and precision.

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Justification

Uganda's doctor-patient and nurse-patient ratio is approximately 1:25000 and 1:11000 respectively which is way below the WHO recommended ratio of 1:1000 for doctor-patient.

Hypoxemia occurs in 20 % of Neonates in low resource settings, 6% of all children under 15 years, and 9% of adults admitted to hospitals in Sub-Saharan Africa are hypoxemic.

Manikin-based studies for evaluation of ventilation performance showed that all professionals tend to cause hyperventilation.

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Objectives

Main Objective

Design and implement an automated bag valve mask (BVM)-based resuscitator.

Specific Objectives

- Design and construct a mechanical unit responsible for the delivery of oxygen to the patient.
- Synchronize the pressing of the bag with the breathing of a patient.
- Construct an electronic control circuitry that is based on an ATmega328P Microcontroller.
- Design a pressure relief valve to contain the pressure su

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Methodology

Objective 1	Make a 3-D design using SOLID WORKS Integrate the parts, that is, a wiper motor, motor support, pressing arms, timing wheel, and BVM. end
Objective 2	▶ Design a contact switch that consists of fine wires, one of which is attached to the diaphragm. The diaphragm pushes the wire to close the switch as the patient attempts to breathe.

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Methodology (cont'd)

Objective 3	▶ Tension force is created in the string. Excess pressure must act against the Tension to open the valve.
Objective 4	▶ Create schematics of the electronic control circuitry and user interface using Proteus software. ▶ Construct a PCB, integrate power supply, AC and DC ports, and ATmega328P.

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Scope

- The system is to be used by healthcare professionals including doctors, nurses, emergency response teams, and individuals with some level of training.
- It is to be in various medical environments such as hospitals, ambulances, and disaster response units.

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Expected Results

- At the end of the project, the system should mimic how trained medical personnel would manually press the PVC resuscitator.
- Deliver a regulated amount of clean oxygen at specific rates for different age groups.
- Regulate the pressures of the inhaled air to recommended levels.

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Timeline

Figure 2 shows how the tasks of the project will be done throughout the schedule

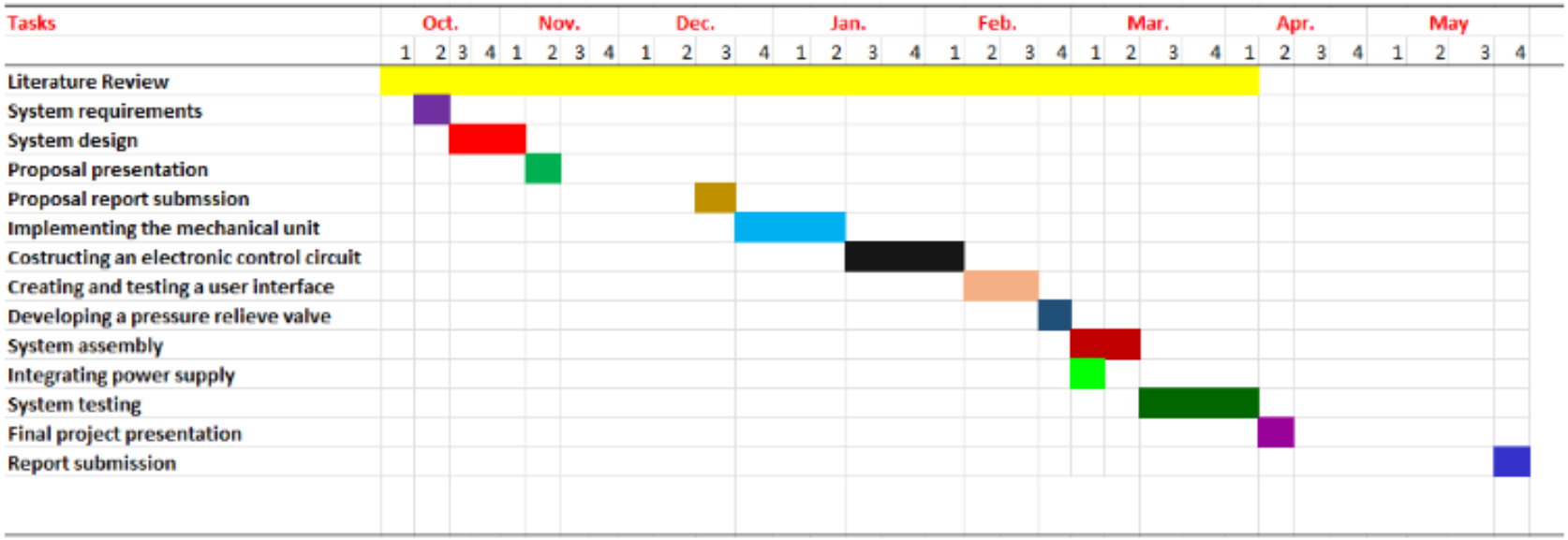

Figure 2: Ghantt chart

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Budget

Table 1: Proposed Budget

Item	Quantity	Unit Cost	Total Cost
BVM	1	95000	95000
Wiper Motor	1	75000	75000
LCD screen	1	35000	35000
Acrylic 6mm sheet	1	140,000	140,000
ATmeg328P	2	16000	32000
Miscellaneous			427,650
Total			**854,650**

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References

[1] Ministry of Health, "National Scale-up of Medical Oxygen Implementation Plan 2018-2022" Jan. 12, 2023 [Online] Available: http://library.health.go.ug/sites/default/files/resources/MOH%20National%20Oxygen%20Scale%20up% 20Plan% 206% 20April %202019.pdf

[2] National Library of Medicine, *"Assessment of the preparedness of the Ugandan health care system to tackle more COVID-19 cases"*[Online]. Available https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7533609/Accessed: Oct 19, 2023]

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Thank You!