SAISMS: Transforming Ammunition Management Through IoT-Enabled Inventory and Safety Monitoring System

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Abstract— **Ammunition plays a crucial role in military and defense operations, requiring significant investments to arm military forces adequately. However, ammunition is susceptible to environmental factors that can degrade its quality, leading to defects or even accidental explosions. To ensure constant combat readiness, it is vital to maintain secure storage facilities with sufficient ammunition supplies. This project aims to enhance ammunition inventory and safety management procedures by leveraging IoT technologies. This project proposed the implementation of an IoT-powered web application dashboard that utilizes weight measurements to provide real-time inventory tracking and monitors environmental conditions such as temperature and humidity for quality control. Additionally, the system can predict ammunition condition outcomes. By adopting this IoT-based solution, ammunition management processes will be streamlined, resulting in improved efficiency and effectiveness.**

Keywords—Internet of Things (IoT), Ammunition Management, Real-time Inventory, web-based application dashboard, Fuzzy-logic model

I. INTRODUCTION

In today's world, the Internet of Things (IoT) has permeated various industries, revolutionized their operations, and brought about increased efficiency and convenience [1-4]. However, in Malaysia, the implementation of IoT technologies, especially within the military and defense sector, remains relatively unexplored, with much of the work still reliant on manual labor. Ammunition, commonly known as ammo, holds paramount importance in military settings. It serves as the lifeline for soldiers, providing them with the means to defend themselves against adversaries. Tragic events like the Bukit Kepong incident [5], where brave Royal Malaysia Police officers fought valiantly against overwhelming communist forces, resulting in significant casualties, underscore the critical role of ammunition availability. The outcome could have been different if a steady supply chain of ammo had been maintained, equipping the officers to hold off the enemy until reinforcements arrived.

In addition to the availability of ammunition, ensuring its quality and safety during storage is a pressing concern. Ammunition is susceptible to environmental factors, such as temperature and humidity, which can degrade its quality over time. Rusting, weapon jamming, and even accidental explosions are unfortunate consequences of poor ammunition maintenance [6]. Such incidents have been experienced in combat scenarios, leading to wasted ammunition and compromising soldier safety. The risk is further exemplified by incidents worldwide involving the storage of ammunition.

Currently, the responsibility of ensuring ammunition availability in military bases falls on Ordnance Officers who manually examine the inventory of each ammo storage facility, typically located in bunkers throughout the base. This labor-intensive process is time-consuming and prone to human error, impeding efficient ammunition management [7]. Additionally, it has become a common practice to leave ammo stockpiles within bunkers without adequate fire suppression or humidity reduction systems, based on the misconception that most munitions are inherently safe. However, certain components, such as a bullet's primer, can be susceptible to oxidation, compromising ammunition quality, causing malfunctions, or even accidental explosion [8]. Furthermore, neglecting the maintenance of ammunition stockpiles has led to instances where old ammunition rusts, and the wooden cases deteriorate, leaving the ammunition exposed to external conditions. This lack of proactive monitoring and maintenance poses significant risks as the readiness of ammunition is compromised, hindering the ability to respond promptly to unexpected situations [9].

There is an existing solution called the "*RFID Armory Management Systems*," developed by Southwest Solutions Group. This advanced system combines the latest in database software and RFID technology to enhance the security, accountability, and efficiency of an armory. Its primary function is to track and inventory weapons, ammunition, and equipment as they are issued, returned, and stored. The RFID Armory Management System ensures a comprehensive chain of custody for each asset by discreetly embedding RFID chips within them. At armory exchange windows, RFID antennas are installed to automatically track assets as they are issued and returned. The system is monitored through a user-friendly touch screen monitor affixed to each exchange window,