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| **SEN2001 – Programming Languages**  **Project Proposal** |
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| **Project Category(Software Implementation / Patent Application):**  Software Implementation |
| **Project Title:**  Improving firearm security with Wave-Safe system |
| 1. **Summary of your project (approx. 400 words, should include the summary and outline of the project as well as your study plans):**   This Project is mainly built around the safety issues that gun operators face while the carrying process and using the firearm. One of the biggest problems that seem obvious but can expose serious harm is that firearms are more dangerous when used by people who are not supposed to use that said weapon. So we think of a system to keep the gun in the operator's hand and not let it fire under the control of unauthorized or incompetent individuals even if they manage to get their hands on the weapons. We aim to solve this problem by using RFID and in addition to that, increase practicality with an integrated digital interface. The safety system will be made of two main parts, a wearable RFID chip looks like a bracelet and a paired system integrated into the firearm which functions as a trigger lock. that lock physically enables the trigger pull only if the paired RFID is in the range, which means the firearm is held by the designated user. The second part is the display unit. That display will show the variables such as safety position, trigger locks current state if the weapon is ready to fire or not which will be an advancement to safety measures. Also, there will be some other information displayed about the condition of the firearm such as the number of rounds left. This Project will not produce a physical prototype on an actual firearm but will implement an interface which will mimic the firearm and the additional systems. There will be a display and two control panels. the display will be the as same as the idea, but not on the gun. The first control panel will mimic the firearm with buttons, the input will be given via that panel. The third panel will act as the safety system and ask the user if the bracelet is near the gun or not. The program we will write will read all that input, give wanted information as an output to the screen, and decides whether the functions will work or not depending on the safety systems information |
| 1. **Literature Review (approx. 10 examples)**   Improving gun safety with an Wave-Safe safety system  Utilizing a firearm is not a topic that you can have loose safety measures. If an accident happens related to a firearm, it could be an accidental discharge, misfire or another reason, it will result in severe injuries, death, and serious damage to the surroundings. And those accidents generally occur while the gun is held by someone who shouldn't. For example a friend of the owner checking the gun, a young individual found it and playing with it just out of curiosity. Also, it's not just accidental events that cause unwanted harm, sometimes the harm is intentional. In professions that allow people to carry guns while working, for example, law enforcement or military officers, they need to make sure their firearm is safe and only accessible by them. Sometimes people who should not have their hands on a gun, and in professional carry, that means everyone other than the employee that carries the weapon, try to hijack the weapon and use it against people they take the weapon from. There are different safety levels and implementations such as holsters with a button to prevent someone just pulling a gun from a belt, safety switches to prevent accidental discharges, lanyards that tie the gun to holsters but they are not safe enough. There are several accidents reported in  which officers end up facing towards their own guns, held by individuals with no good intentions. For example in Los Angeles, an officer in a police building, involved in a fistfight with a civilian which resulted in him falling down, dropping some tactical equipment from his belt including his pistol, and the bad guy grabbing the gun pulling the trigger point-blank [1]. The traditional safety measures are just safe to the point which weapons still in officers' hands or holstered on them, when the weapon is held by the bad guy, it is no longer your weapon.  Our Project is a solution to that with the extra benefit of making weapons more user friendly, we thought of a way that even if someone else has your weapon, the weapon is still yours and will not discharge in someone else's possession. So we think of a system that connects a firearm to a single user. A system to keep the firearm functioning only in the operator's hand and not let it fire under the control of unauthorized or incompetent individuals even if they manage to get their hands on the weapon. There are some studies made to increase gun safety by using controversial methods. For example, there was a trigger system that was made back in the 1970s, it was called the “Magna trigger” which basically is a trigger system that only lets you fire if you have the magnetic ring which interacts with a counter magnet inside the gun[2]. As a more updated and technological approach to gun safety improvement, a teenager named Kai Kloepfer’s solution to gun safety was fingerprint scanners located in the grips of pistols [3]. He first thought that iris scanners could be a good option but later he thought of sunglasses and he moved to the fingerprint scanners, Kai said his system could store up to a thousand different fingerprints and have a success rate of 99.9 percent [4]. These are solutions that could be improved but there are still weak points. to give an example in combat situations operators use gloves, even the environment itself will cause problems while using a scanner that sits outside. Considering war environment, a weapon should be working in snow or dust, hot or cold, and could easily absorb every shockwave that comes with firing, but fingerprint scanners are working with input given from the surface, so when integrating one in a firearm there must be a compromise given from case integrity which will increase the cost of water-dust proofing. Besides, reading fingerprints in wet conditions is not the strongest suit of a scanner. In contrast to that RFID systems can not just perform well in wet conditions, they can work also work underwater[5] Even without all of these problems, user can only hold the gun in a single way to utilize the scanner while firing and this is not user friendly. An operator should be capable of using a weapon with different techniques, depending on the place which can be a room with tight corners or behind a car window. Also, a fully integrated system will be hard to maintain. In a summary, the most common approach for smart gun safety is fingerprint scanning guns, and they have three main weak points. First, they need an input surface so they are not suitable for rough and especially wet terrains. Second, they are not compatible with combat wear like gloves. And fınally those systems are fully integrated with all of the needed hardware so maintenance costs are high. Our Project utilizes RFID systems and they will not cause those drawbacks of fingerprint scanning weapons. Our Project will solve the maintenance problem, to maintain a fingerprint scanner a weapon in which the scanner is embedded must be disassembled and disassembly will be required even for the most basic things like battery changes or a simple cleaning. In contrast, RFID systems have two tag types, active tags, and passive tags, passive tags are capable of using the power of readers, therefore they operate without a battery[6]. This means there is no need for frequent changes and this will decrease the maintenance and production cost. RFID systems work with two main parts, a reader and a tag, and the system will function if those are close enough, so whether the operator wears gloves, injured his finger during an operation, or completely soaked the weapon in the dirt, if the reader and the tag are close, all functions will be working. In This Project, the trigger pull will be restricted by a metal pin which can go up and down to block movement in the triggers pull direction. That mechanism will work with an RFID reader and an RFID tag, the tag will be embedded in the trigger guard to not alter the firearms ergonomics, the reader will be in a bracelet shape which also will work as an information screen. When the operator holds his firearm with the bracelet on the wrist, the reader and the tag will be close enough and the system will pull the pin down, therefore enables the trigger to pull and fire. If the bracelet is not on the person who is holding the firearm, the mechanism will block the trigger pull therefore there will be no firing action even if the person tries to pull the trigger. The bracelet will have a screen on it and that screen will feed the operator with critical  information. For example, when the operator pulls the slide, fires the gun and the danger is not present anymore so the operator holsters the gun without pulling the slide and taking that one bullet in the chamber manually, the next gun pull won't require a slide pull because there is a bullet in the chamber, the bracelet will alert the user about the bullet in the chamber. That way the operator will not lose time checking the chamber, will not lose focus trying to remember is there a bullet in the chamber or will not pull the slide when unnecessary and cause a jam in a situation where seconds decide whether there will be casualties or not. To implement these actions and demonstrate them we will make a GUI application using java. The application will have a control panel that will simulate a firearm and an actual screen that shows information which will simulate the bracelet screen. With the implementation of this Project, lots of safety issues mentioned above will be solved without the serious drawbacks of other technology-based safety systems.  [1] RICHARD WINTON, KEVIN RECTOR (september, 2020) “Video shows man pistol-whipping LAPD officer in police station, pointing cop’s gun at him”  Available: https://www.latimes.com/california/story/2020-09-28/suspect-pistol-whips-lapd-officer-inside-police-station  [2] Popular Science (december, 1976) pp.26 available: https://books.google.co.zm/books?id=7wAAAAAAMBAJ&printsec=frontcover&hl=tr&source=gbs\_ge\_summary\_r&cad=0#v=onepage&q&f=false  [3] Geoffrey A. Fowler (october 2016) “A 19-Year-Old Just Built the First Fingerprint-Reading Smart Gun” available: https://www.wsj.com/articles/a-19-year-old-just-built-the-first-fingerprint-reading-smart-gun-1475850207  [4] Nicholas Kristof (jan, 2015) “Smart Guns Save Lives. So Where Are They?” available: https://www.latimes.com/california/story/2020-09-28/suspect-pistol-whips-lapd-officer-inside-police-station  [5] Tracy J. HarastiJames E. HowellWilliam M. Hertel “Underwater RFID Arrangement for Optimizing Underwater Operations” US Patent US20110095865A1 |
| 1. **Project details & Flowcharts**     The program starts when a method named tagRead is called in safetyMechanism.  tagRead continuously receives the distance between the gun and the bracelet in the form of integers from measureDistance and it decides in an infinite loop which Boolean value should be returned to safetyMechanism according to the argument given. safetyMechanism checks the returned Boolean value and if it is true, it will proceed and send instructions to controlPanel and discharge and if it is false, then it will wait until tagRead returns true, anyhow it will displays the information on the bracelet screen using GUI\_A for the user. The controlPanel upon receiving the signal, it unlocks the trigger, pullSlide, and reload. As the gun is fully functional now, discharge receives signals from trigger being pulled and sends instructions to bulletCounter and checkChamber to display the new amount on the screen using the GUI\_B method. The bulletCounter method will display the current updating number of bullets in the mag and the checkChamber method will display if the gun is ready to fire. The reload would ask the bulletCounter method to count the new number of ammos in the mag and update it on screen. |