TRAIL LOCATER FOR FIREMEN

By

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FINAL PROJECT REPORT

Submitted to the Department of Electrical & Electronic Engineering
in Partial Fulfillment of the Requirements
for the Degree
Bachelor of Engineering (Hons)
(Electrical & Electronic Engineering)

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CERTIFICATION OF APPROVAL

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Approved:

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Project Supervisor

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May 2012

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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Muhammad Adam Bin Husain Marican

ABSTRACT

Firemen are well trained to rescue fire victims. As firemen rescue the victims, the danger does not only face by the victims but firemen as well. Examples of danger faced by firemen are oxygen tank run out or unconscious due to impact of an object on the head. So a system must be implemented to observe current conditions of firemen during fire rescues. Saving that firemen require their position inside the building which is unidentified. Even if the position of the fireman is traceable, the way to get there is still unknown. Getting the way to the position is hard due to visual limitation as fire and smoke is all around. Therefore trail identification system is needed to track exactly the path traveled. A trail marking system includes signal tracking and the devices used must be able to withstand heat. Typical electronic devices includes RFID transmitters are not able to withstand high temperature. Therefore, applying heat and fire insulation to the devices is needed. The challenge is to find the right materials for insulation which allow signal transmission.

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CHAPTER 1
INTRODUCTION

Tracking system allows tracking and identifying the location of objects in real time. Using simple, inexpensive badges or tags attached to the objects, readers receive wireless signals from these tags to determine their locations. RFID is typically refers to systems that provide passive or active collection of location information. Location information usually does not include speed, direction, or spatial orientation. These additional measurements would be part of navigation, maneuvering or positioning system. [1]

One of the earliest tracking is Long Range Navigation (LORAN). Using some real time measurement to calculate distance between a receiver and 3 stations, the geographic position of it can be determined. Global Positioning System (GPS) is the next development using the same principle of LORAN. The different is the distance is measure from receiver to satellites as outer space stations. Radio Frequency Identification (RFID) also one of the tracking systems existed and broadly applied by various countries. The ranges of RFID transmission are small which is up to few meters. [2] [3] [4]

1.1 Problem Statements

Currently, there is no safety monitoring system for firemen during emergency fire rescue which is: if anything happen to a fire fighter, there is no single trace left to follow.

- Location and path travelled by fireman during fire rescue is unknown
- Fireman trails or actual steps are not viewable
- Manual marking method adds more task to fireman

1.1.1 Problem Identification

A fireman collapsed during fire rescue and he need to be saved. Therefore the path travelled by the fireman must be obtained. Tracing the path involved tracing the marking made by that fireman. Details of marking:

- The marking is done for every certain length automatically so that the fireman can focus on fire fighting and rescue
- The marking should be able to withstand the fire until fire rescue accomplished
- The marking should be able to transmit the location to the fire engine outside
- Marking made by every fireman can be recognized
- The marking must be static after positioned to achieve precise trails location

1.1.2 Problem Significant

This project increases the efficiency of saving a collapsed fireman. Although this situation is unwanted, but anything can happen as fireman gambled their life to save others. Conventionally, to save a fireman, another fireman will rushed in and search every single portion of the building. Locating the position of in danger fireman takes time and hardly determined as the visibility of surrounding is not clear due to presence of fire and smoke. Even the location to the fireman might be known, the path travelled is still not obtained. Knowing the path shortened the fireman rescue as one step is skipped.

1.2 Objectives

Below are the objectives of this project:

- Design an auto marking mechanism of trail locater to be embedded to firemen oxygen tank
- To develop trail locater which shall be monitored from fire engine
- To develop trail locater which can withstand heat and fire
- To develop an automatic system that drops the locater at a predefined distance

CHAPTER 2
LITERATURE REVIEW

Tracking system is observing of persons or objects on the move and supplying a timely ordered sequence of respective location data to a model e.g. capable to serve for depicting the motion on a display capability. [5] Application of tracking includes vehicle tracking in fleet management, asset management, individual navigation, social networking, asset management and mobile resource management. In real application, there are a variety of technologies employed within asset tracking systems in order to control the remotely. Tracking aspects has different discrete hardware and software systems for different applications.

2.1 LORAN

Long Range Navigation (LORAN) is a radio navigation system which enables ships and aircraft to determine their position and speed from low frequency radio signals transmitted by fixed land based radio stations to a receiver. The most recent version of LORAN in use is LORAN-C, which operates in the low frequency (LF) operates from 90 to 110 Kilohertz. United States, Japan, and several European countries are nations that already used LORAN system. [2] [4]

2.1.1 *Working Principle*

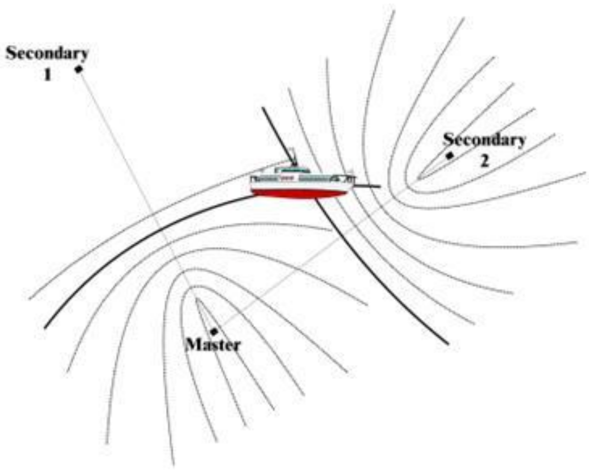

Figure 1: LORAN Tracking System Principle [4]

Loran was created during World War 2 to determine the position of ships and aircraft. Working principle is to calculate the distance between the receiver and three radio stations. The stations are named as the master, secondary 1 and 2 secondary. The time difference from the parent to a secondary receiver to identify a master curve and the secondary receiver 2 identifies another curve. Cross-section of both curves is the recipient of geographical time difference. [4]

2.1.2 *Application*

Loran system was invented during World War II after the development of the Massachusetts Institute of Technology (MIT) Radiation Laboratory and was used extensively by the United States Navy. LORAN-A saves many lives by allowing offshore boats in difficulty to give accurate position reports and also helped many boat owners who cannot afford radar safely into fog bound harbors or around treacherous offshore reefs. Low price surplus Loran-A receiver (usually $ 150) means that owners of small fishing vessels capable to afford these appliances. This improved security and safety. The emergence of surplus equipment may be refined cosmetic factor. [6]

On May 7th 2009, President Barack Obama proposed deduction of financing (approximately $ 35 million / year) for Loran, citing termination in addition to pending Congressional bill, HR 2892, it was later announced that the Administration supports the goals of the Committee to reach the termination organized through the beginning stages of termination in January 2010, and certification requirements will be provided to document that the termination of the Loran-C will not affect the ability of maritime security or development may be GPS or need backup. [7]

2.1.3 Limitation

LORAN suffers from electronic effects of weather and the ionospheric effects of sunrise and sunset. Groundwaves which propagates over the Earth’s surface is the most accurate signal. It is assumed to be the most ideal for a groundwave to propagate over sea water. Skywaves are bent back to the surface by the ionosphere to have wider connection but becomes a problem as multiple signals from different paths may arrive at the same time. The ionosphere's reaction to sunrise and sunset affects the particular disturbance during those periods. Magnetic storms have negative impact to any radio based system. [4] [8]

LORAN uses ground based transmitters that only cover certain regions. LORAN coverage is good in North America, Europe, and the Pacific Rim. [8]

2.2 Global Positioning System (GPS)

Advances in technology and new demands on the existing system have now led to efforts to GPS system. Artificial satellites are the inventions towards developing tracking and navigating system. Satellite is made to orbit around the Earth and allows signal transmitting and receiving. On October 4, 1957, the first artificial satellite was launched by the Soviet Union known as Sputnik 1. [9] Sputnik 1 was used to identify the density of high atmospheric layers. Measurement was taken by observing its orbital change and the data was provided on radio-signal distribution in the ionosphere. [10]

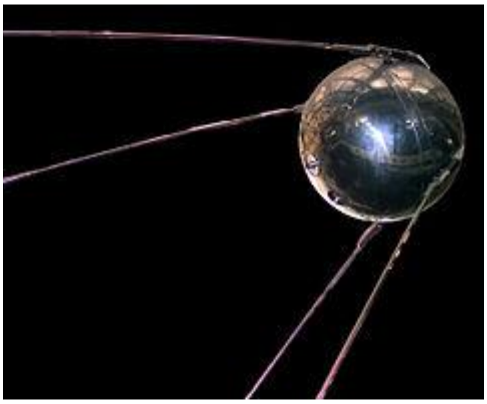

Figure 2: Sputnik Sattelite

There are many types of satellites invented includes navigational satellites. Navigational satellites use radio time signals transmitted to enable mobile receivers on the ground to determine their exact location. The relatively clear line of sight between the satellites and receivers on the ground, combined with electronics invention, allows satellite navigation systems to measure location in real time. The major different of working principle; LORAN used land based transmitting stations as references, in contrast to GPS, outer space transmitting stations is used as references. [9] [8]

2.2.1 Working Principle

GPS satellites which are orbiting the earth send signals and based on the signal timing, a GPS receiver calculates its position. Each satellite continually transmits signal that include

- the time the signal was transmitted
- precise orbital information
- the general system health and rough orbits of all GPS satellites

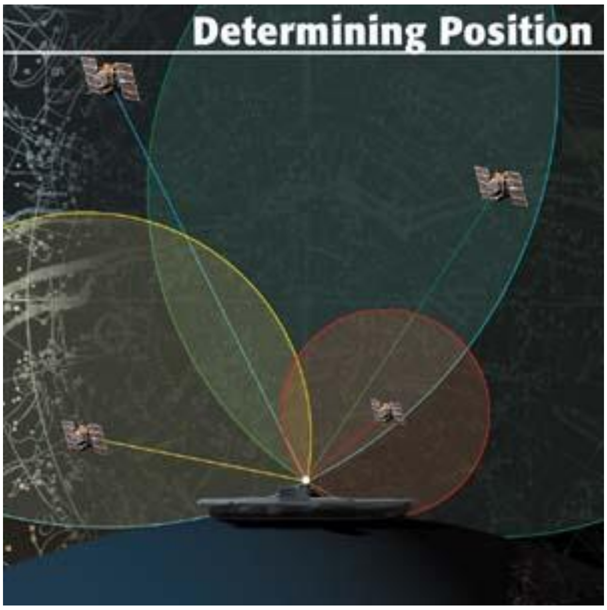

Figure 3: GPS Tracking System Principle [11]

Using these 3 attributes, GPS provides latitude, longitude and altitude. Practically, minimum of four satellites must be seen by GPS receiver to provide the position This position is then displayed, perhaps with a moving map display or latitude and longitude; elevation information may be included. Many GPS units show the information obtained such as direction and speed, calculated from the changes in position. [3] [11]

Table 1: GPS Frequency Overview [12]

Band	Frequency	Description
L1	1575.42 MHz	Coarse-acquisition (C/A) and encrypted precision P(Y) codes, plus the L1 civilian (L1C) and military (M) codes on future Block III satellites.
L2	1227.60 MHz	P(Y) code, plus the L2C and military codes on the Block IIR-M and newer satellites.
L3	1381.05 MHz	Used for nuclear detonation (NUDET) detection.
L4	1379.913 MHz	Being studied for additional ionospheric correction
L5	1176.45 MHz	Proposed for use as a civilian safety-of-life (SoL) signal.

2.2.2 Applications

1. Navigation in army- GPS allows soldiers to navigate, coordinate troop and supply movements. They can maneuver even in the dark or in unfamiliar territory. In the U.S. military, GPS devices are different for every rank. Commanders use higher performance of GPS compare to lower ranks' devices. [11]

2. Geofencing: GPS is used in vehicle tracking systems, person tracking systems and pet tracking to locate the subject. These devices are installed or attached to the subject such as vehicle, person, or pet collar. The application provides continuous tracking and mobile or Internet updates and notify if the subject leave the designated parameters. [8]

2.2.3 Limitation

Due to the low received signal strength of satellite transmissions, they are vulnerable to be jammed by land-based transmitters. Such jamming occurs inside a geographical area within the transmitter's range. Apart from GPS satellites, but satellite phone and television signals have also potential to jam the signal. [12] [13]

It is also not difficult to transmit a carrier radio signal to a geostationary satellite and thus interrup with the rightful uses of the satellite's transponder. It always occur that earth stations transmit at the wrong time or on the wrong frequency in commercial satellite space, and dual-illuminate the transponder, cause the frequency can not be used [14]

A GPS receiver must be able to be seen by satellites. As the GPS receiver is inside a building, the ceiling and rooftop would block the view from GPS satellites. [15]

2.3 Radio Frequency Identifcation(RFID)

Radio-frequency identification (RFID) is a system that use wireless non-contact system by utilizing radio-frequency electromagnetic field Data is sent from a tag to enable tracking and each data has identification which is used for the purpose of recognition. A radio-frequency identification system uses tags or labels attached to the objects. [16] Readers are used in the two-way radio transmitter-receivers by sending a signal to the tag and read its response and RFID middleware which is a computer which has RFID software running uses readers to read the data for thorough observation. [17]

2.3.1 Working Principle

Figure 4: RFID Basic Components and System

RFID main systems are tags, readers and host computer. The tags contain identification or location information as data to be transmitted. The transmitted data will be read by the reader. There are two type of RFID tag tracking; active and passive. Active tracking refers to tracking on moving tags while passive tracking is tracking on static tags. Using the same tag used for passive to track active subject is not possible. Therefore active tags are powered by battery. Thus the read range of the tag is amplified up to 300 feet or more. As for passive tags, they use energy harvesting which is known as capturing energy externally to power up. RFID tags use energy from RFID reader signal to power up circuitry, and transmit back to the reader. [17]

Table 2: RFID frequency Overview [18]

FREQUENCY RANGES	COMMENT	ALLOWED FIELDSTRENGTH
< 135 kHz	low frequency, inductive coupling	72 dBµA/m max
6.765 .. 6.795 MHz	medium frequency (ISM), inductive coupling	42 dBµA/m
7.400 .. 8.800 MHz	medium frequency, used for EAS (electronic article surveilance) only	9 dBµA/m
13.553 .. 13.567 MHz	medium frequency (13.56 MHz, ISM), inductive coupling, wide spread usage for contactless smartcards (ISO 14443, MIFARE, LEGIC, ...), smartlabels (ISO 15693, Tag-It, I-Code, ...) and item management (ISO 18000-3).	60(!) dBµA/m
26.957 .. 27.283 MHz	medium frequency (ISM), inductive coupling, special applications only	42 dBµA/m
433 MHz	UHF (ISM), backscatter coupling, rarely used for RFID	10 .. 100 mW
865 .. 868 MHz	UHF (RFID only), Listen before talk	100 mW ERP Europe only
865.6 .. 867.6 MHz	UHF (RFID only), Listen before talk	2W ERP (=3.8W EIRP) Europe only
865.6 .. 868 MHz	UHF (SRD), backscatter coupling, new frequency, systems under developement	500 mW ERP, Europe only
902 .. 928 MHz	UHF (SRD), backscatter coupling, several systems	4 W EIRP - spread spectrum, USA/Canada only
2.400 .. 2.483	SHF (ISM), backscatter	4 W - spread spectrum,

GHz	coupling, several systems,	USA/Canada only
2.446 .. 2.454 GHz	SHF (RFID and AVI (automatic vehicle identification))	0.5 W EIRP outdoor 4 W EIRP, indoor
5.725 .. 5.875 GHz	SHF (ISM), backscatter coupling, rarely used for RFID	4 W USA/Canada, 500 mW Europe

Table 3 : Passive vs Active RFID tags [18]

PASSIVE		ACTIVE
Energy transferred from the reader	Power	Battery Powered
Shorter range	Communication Range	Longer Range
Within the RF Field	Availability of tag	Continous
Up to 10 years depending upon the environment the tag is in	Tag Life	3-8 years depending upon the tag broadcast rate
Less in cost or more depending upon quantity and durability	Tag Cost	More expensive and depending upon the available option(sensor)
Small read/write(128 bytes)	Data Storage	Large read/write
Typically higher cost	Reader Cost	Typically lower cost

Basically, there are four different characteristics pertains data storage capability in RFID tag which are [18]:

a) Data Capacity

As for example, a library tags typically have space for 256 bits of information which is more than enough for current system requirements. Apart from that, some tags have room for up to 2,084 bits of information. Therefore, it can be said that this is one of the advantages in RFID system that overcomes the lack of information that can be stored in previous barcode system.

b) Read/Write Characteristics

This characteristic allows information to be stored in the tag and then it can be updated and modified when necessary. However, not all type of tags has this feature. The read only feature allows data to be written once.

c) Password and Encryption
Data in the RFID tags are encrypted to provide extra and additional security to the user and system. Only the RFID readers that contain the encryption code would be able to pass the password encryption before deciphering and reading the data from the encrypted tag.

RFID readers are classified into two types. The two types of the readers are [18]:

a) Fixed RFID reader
Reader read the tags in a fixed position and it is setup in specific interrogation parameters and creates a “bubble” of RF energy that can be controlled precisely

b) Mobile RFID reader
Reader is designed as mobile to provide contentment when reading the tags. Example of RFID readers includes handhelds reader and vehicle mounted RFID readers.

The host computer is a compulsory in any RFID system. Personal computer (PC), laptop, server or a workstation as long as they can run database and control software, hosting RFID systems is possible. The host computer is the brain of the RFID system and every information’s collected from the tags are processed by the host. The RFID reader will refer the tag's data and compare within its self-storage database. Latest data will be sent to the database. Either modifying some parts of the data or replaced the data with new is up to the programmed software. The readers and the host communicate through wireless link. The security of the link guarantees only host and readers would be able to communicate for safety. [19]

2.3.2 Applications

RFID LANDMARK NAVIGATION AUXILARY SYSTEM [20]

Autonomous mobile robots are invented for a vast of applications in service and industry applications. Majority of applications are facing the problems which is the robust and not delicate positioning, i.e. the determination of the robot's current position. A navigation system is applied, utilizing radio frequency identification (RFID) as artificial landmark system. Current application of landmarking system enables the robot to position itself in its surrounding through a topological robot positioning approach. A technique called re-classification (which depends on the special features and advantages of RFID systems) is presented that makes it possible to determine the robot's exact global position in presence of a landmark. Based on this accurate position (i.e. its coordinates) the robot can reach an arbitrary goal specified by coordinates even if it is not marked with a RFID landmark.

RFID TAGS BASED ON VIRTUAL LANDMARKS AND MOBILE READERS [21]

The most famous RFID localization method is LANDMARC (LocAtioNiDentification based on dynaMic Active Rfid Calibration). Landmarks are fixed for every certain distance as reference tags. The location of those tags are known by the system and the system interprets those as a radio map. As soon as active RFID tags turn up inside the fixed tags, using a tag reader with Received Signal Strength (RSS) method, the distance between the active tags and fixed tag can be calculated. Then the distance between the reader and active tags can be estimated by having fixed tags as references. Time Difference Of Arrival (TDOA) method is another alternative to estimate distance using signals emitted from a tag to three or more readers. Recently, radio frequency identification (RFID) technology has been favored to localize robot as it is able to cope with disturbance such as lighting and obstacles compare to conventional method such as camera and supersonic waves. Previously, RFID was not well detailed as possible even though advantages of RFID are very clear, able to fulfill inexpensive mass production. For that time being, RFID is emphasized to dot an area as landmarks.

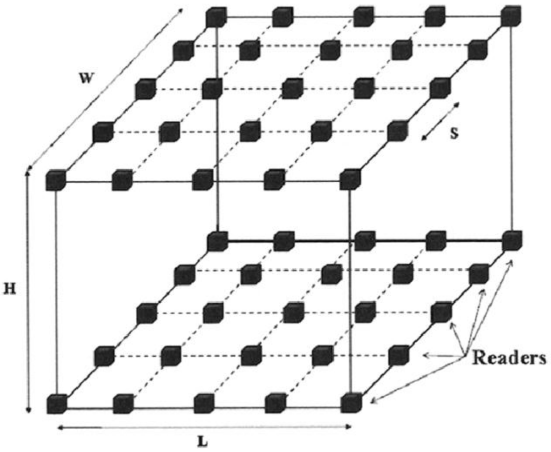

Figure 5 : RFID tags planted in WABOT-HOUSE

As shown in Figure 5, WABOT-HOUSE Laboratory of Waseda University has been chosen to apply the techniques for this project. RFID tags were fixed at 300 mm intervals. This project simulates an environment for a robot to live with human. The hypothesis made is in future the suitable infrastructure to be built is fixing RFID tags for an interval. Using Monte Carlo localization, robot’s position can be estimated. Based on the results and discussions, robots can localize their position very well using the proposed method with right positions of readers.

2.3.3 Limitations

RFID ranges is reduced as more obstacles around such as wall, doors and ceiling which made of concrete and metal. These materials reduce RFID capabilities. Overcoming this limitation, signal repeater is considered. Signal repeater works by rebroadcast exactly as the signal read. Typical repeater use single antenna to receive and transmit signal. The repeater's receiver is made to be very sensitive to signals. As a signal from a transmitter goes further, its strength becomes weaker. Therefore by applying signal precisely at the suitable weakest point, the ranges of the transmitter can be wider. Below shows how repeater works. [22]

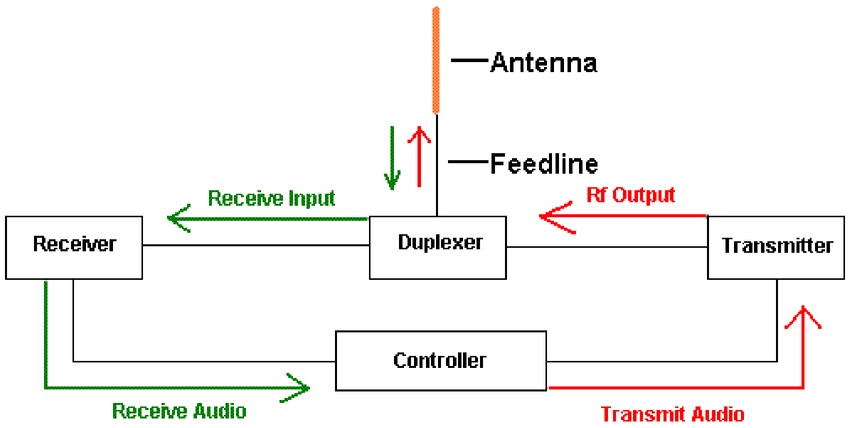

Figure 6: How Repeaters Work

CHAPTER 3

METHODOLOGY

This section is divided into four parts:

- Research Methodology
- Project Gantt Chart
- Tools Required
- Project activities

3.1 Research Methodology

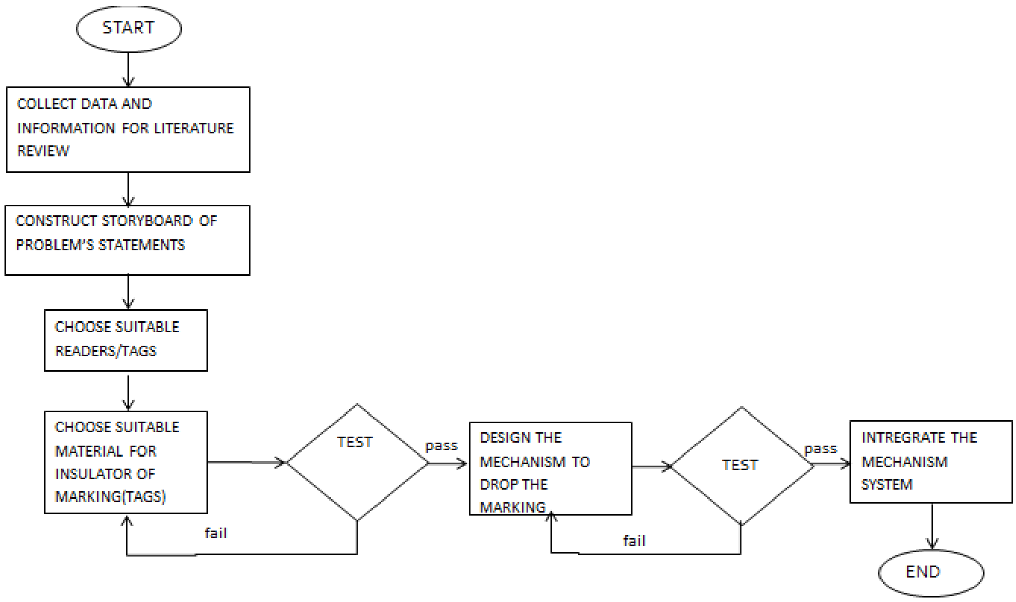

Figure 7: Research Methodology Flow Chart

3.2 Project Gantt Chart

ACTIVITIES	FINAL YEAR PROJECT 1													
	WEEK NO.													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Selection of Project Topic	■	■												
Preleminary Literature Review		■	■	■										
Visit Company					■									
Due of Extended Proposal						■								
Hardware and Software Selection					■	■	■	■	■	■	■			
Conduct Experiment and Perform Testing								■	■	■	■	■		
Proposal Defense									■					
Critical Research Work							■	■	■	■	■	■		
Draft Final Report												■	■	
Due of Final Report														■

Figure 8: Project Gantt Chart

3.3 Tools Required

The proposed system required both software and hardware. MPLAB IDE and PICkit are used to program the Programmable Integrated Circuit (PIC). Hardware used for testing is SK40c and its programmer.

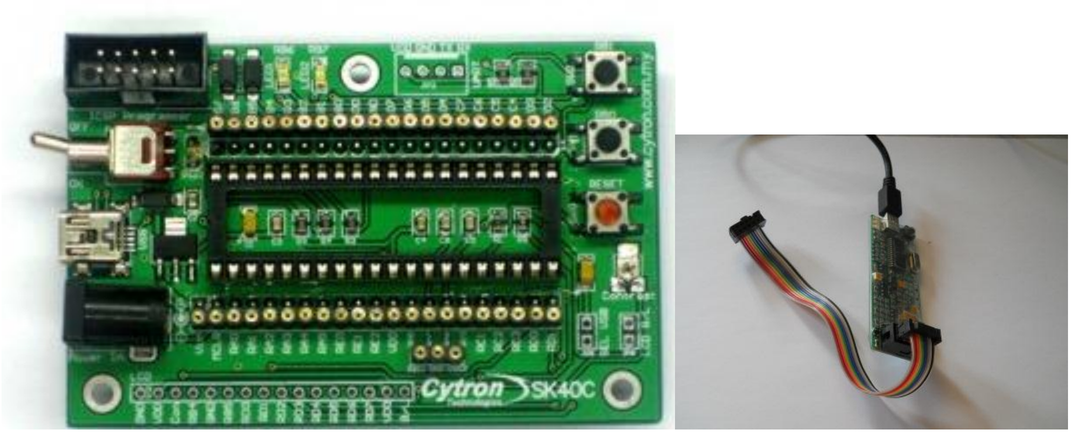

Figure 9: SK40c and Programmer

3.4 Project Activities

The proposed system required both software and hardware. MPLAB IDE and PICkit are used to program the Programmable Integrated Circuit (PIC) to control trail dropping mechanism. Autodesk Inventor 2013 is used to design the trail dropper casing and trail locaters. As proving the concept, several activities were carried:

- Making trail locaters
- Making the casing
- Making the pushing mechanism

3.4.1 Making Trail Locaters

Main items for each trail locaters are several layers of Perspex 2mm, 4 IR LEDs, one 3v battery and one switch. The task is to make the trail locaters can be seen inside the smoke and to switch on the trail circuit immediately before dropping the trail locaters for easiness to user.

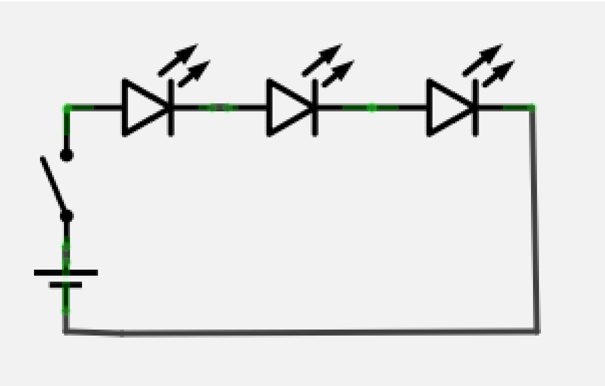

Figure 10: Circuit Diagram For Coin

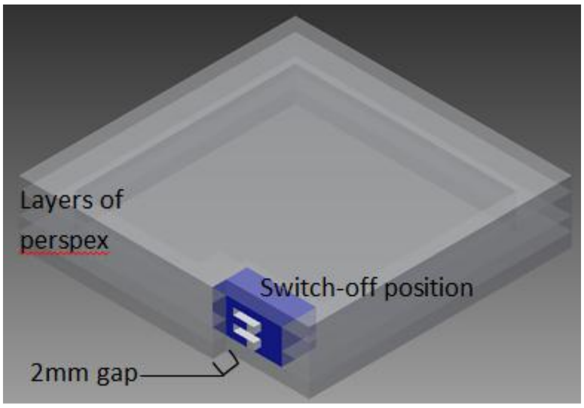

Figure 11: Trail Locater Drawing Design

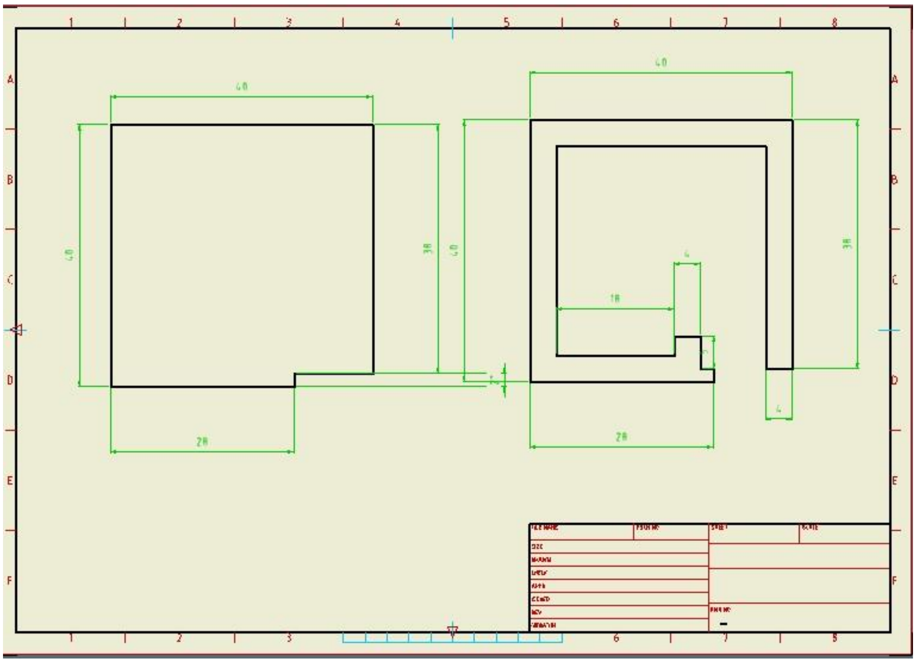

Figure 12: Drawing of Locater in 2dDrawing of Locaters in 2D

Referring to Figure 11, each locater are made of several layers of 2mm thickness perspex to make a room for infrared LED circuit. The drawing was made as shown in Figure 12 and sent to UTP block 16 to cut the perspex using laser cutting tools.

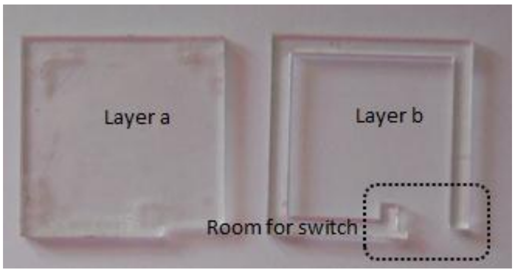

Figure 13: Layers of Locaters

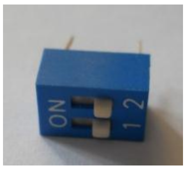

Figure 14: Switch Used for Locaters

Figure 13shows perspex layer cut by laser cutting tools. Each locater is made of two layer a and 3 layer b. Summation thickness of the locater would be 10mm. The switch in Figure 14 will be used and plugged in the locaters.

Figure 15: Ready Made Trail Locaters

4 IR LEDs and 1 battery were connected in series and mounted inside of the locater as shown in Figure 15.

3.4.2 Making the casing

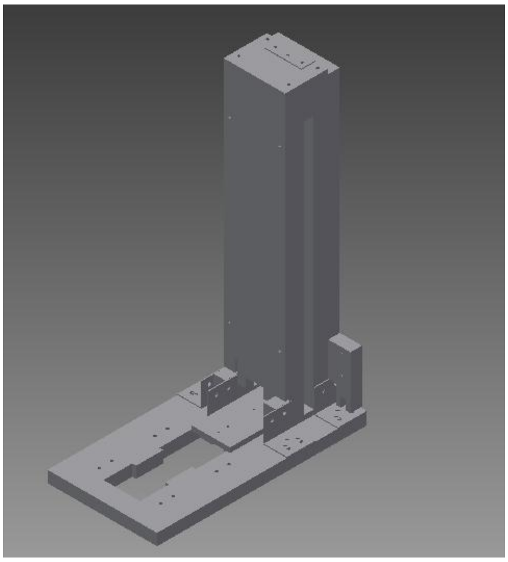

Figure 16: Trail Locater Casing

Using Autodesk Inventor 2013, design of casing to drop trail locaters was made as shown in Figure 16. The material for the casing is perspex 12mm. The drawing was made as shown in Figure 17 and sent to UTP block 16 to be cut using laser cutting tools.

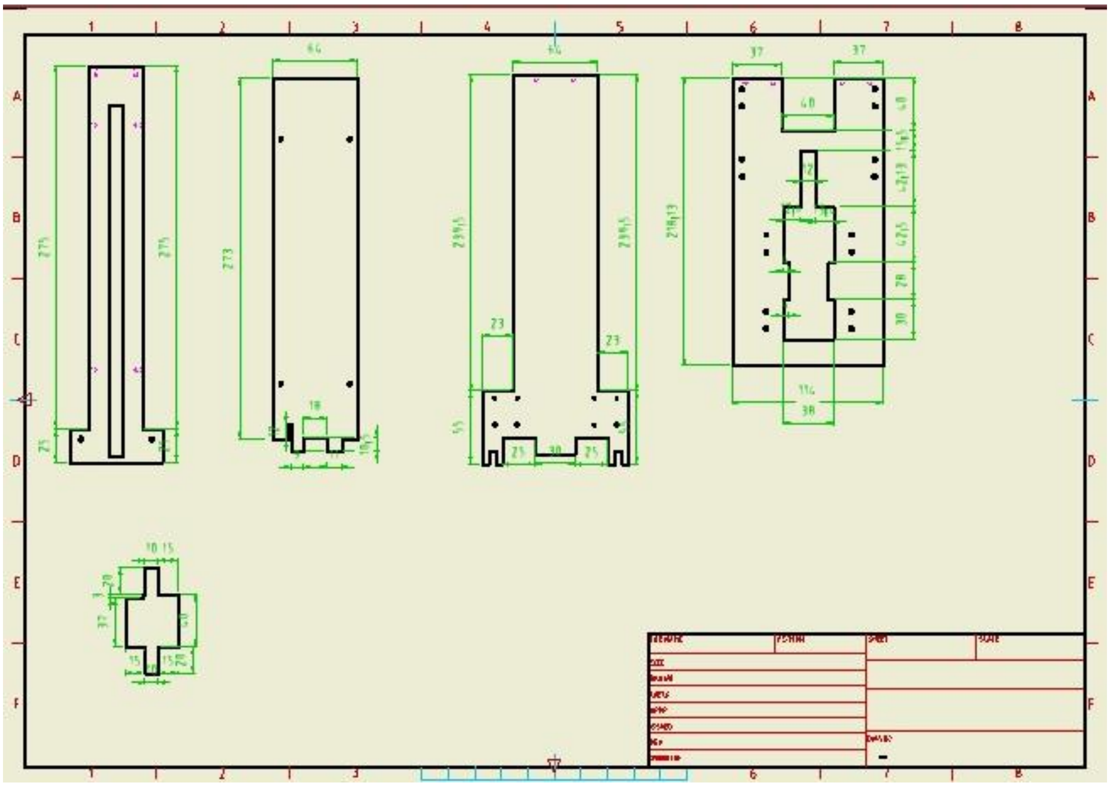

Figure 17: Casing Drawing

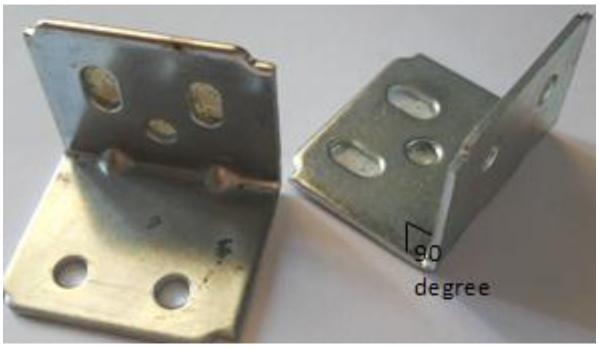

Figure 18: L connectors

L connectors are considered to be used in the casing design to connect to plane of perspex perpendicularly. By using L connectors, casing design was made firmly.

3.4.3 Making the pushing mechanism

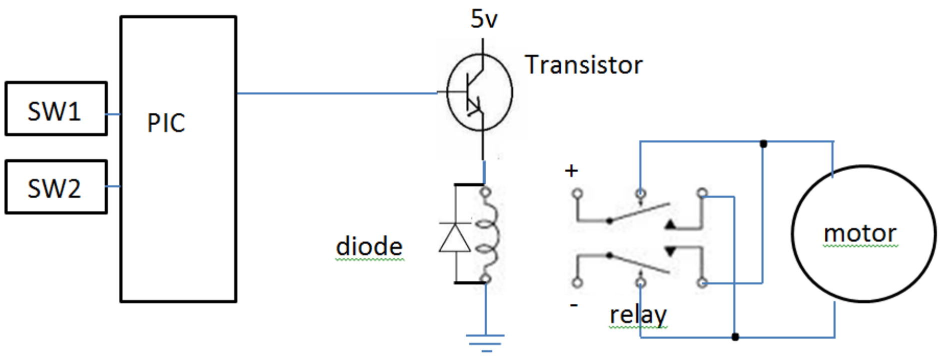

Figure 19: Circuit for Motor Control

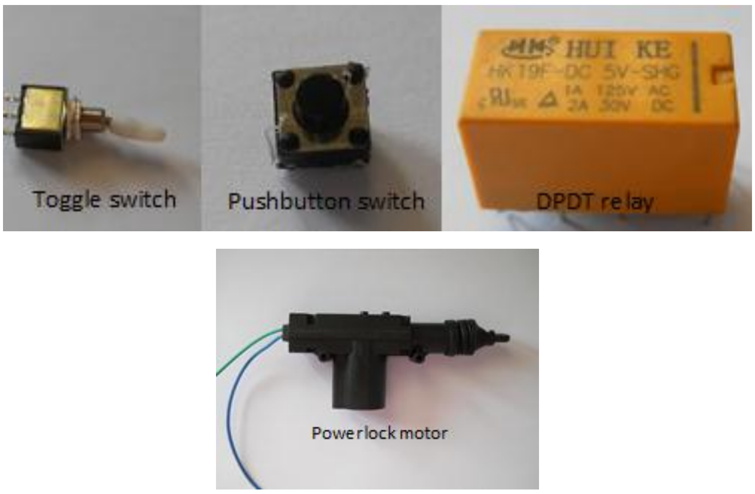

Figure 20: Components used

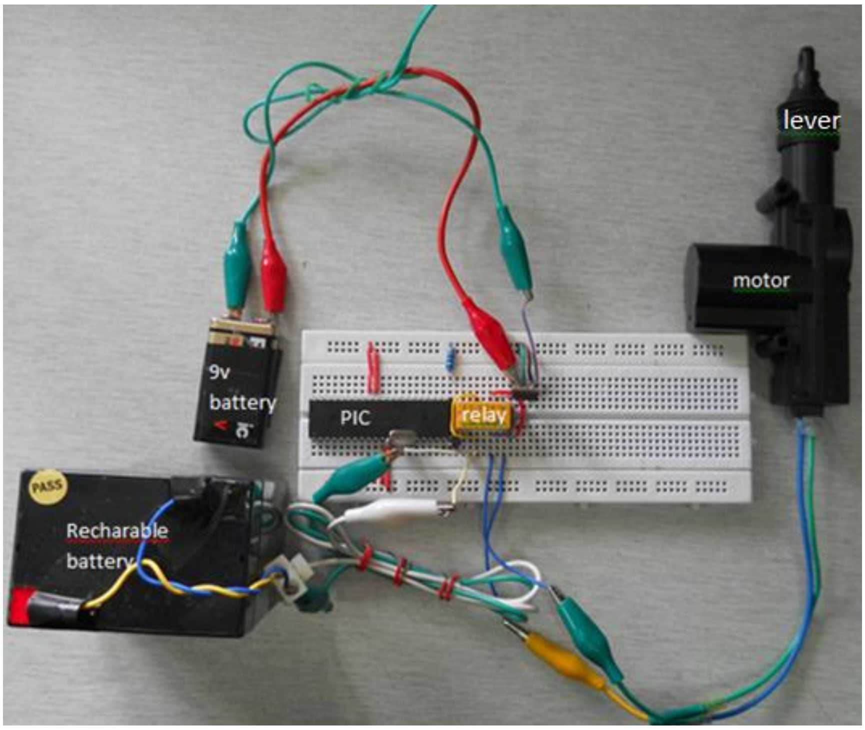

Figure 21: Circuit To Control Powerlock Motor

The circuit to control power lock motor was set up as shown in Figure 21. The circuit consists of Main component involved are switches, diode, transistor, Double Pole Double Throw (DPDT) relay and powerlock motor.

Figure 22: Powerlock Motor Testing

Power lock motor was tested. Referring to Figure 22, powerlock motor lever will shrink as negative voltage is applied and expand when positive voltage is applied. Thus the circuit in Figure 19 is used to control voltage sent to motor.

CHAPTER 4
RESULT AND DISCUSSION

There are some results derived from project activities.

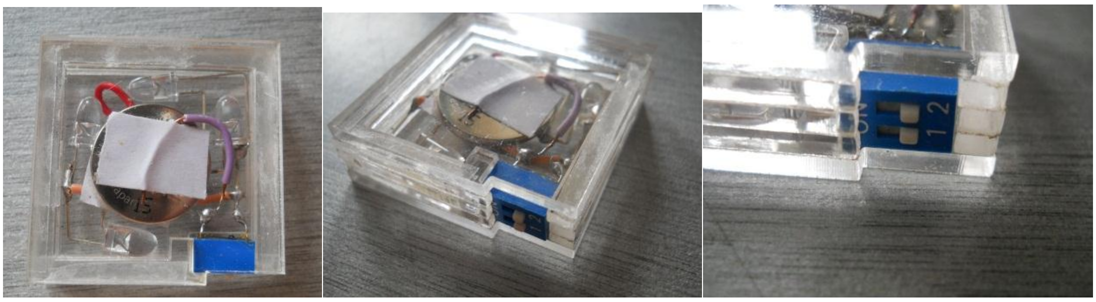

Figure 23: Coin 1st Prototype

Based on circuit diagram, Figure 10 drawing, 1st prototype was made as shown in Figure 23. This step required thoroughly skills as inaccuracy may lead to failure for future used. The switch is located at the corner of the coin so that the casing made will be able to switch on the IR LEDs before dropping them.

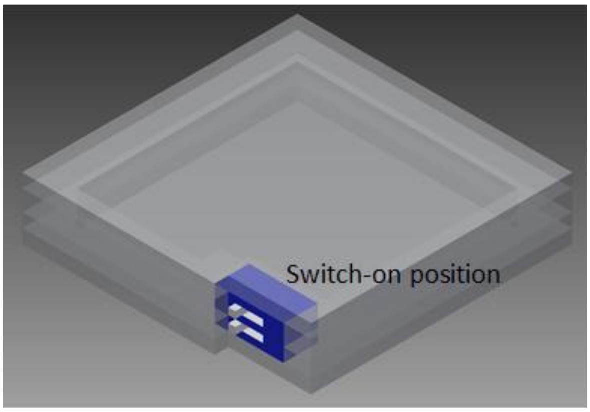

Figure 24: Trail Locater-ON position

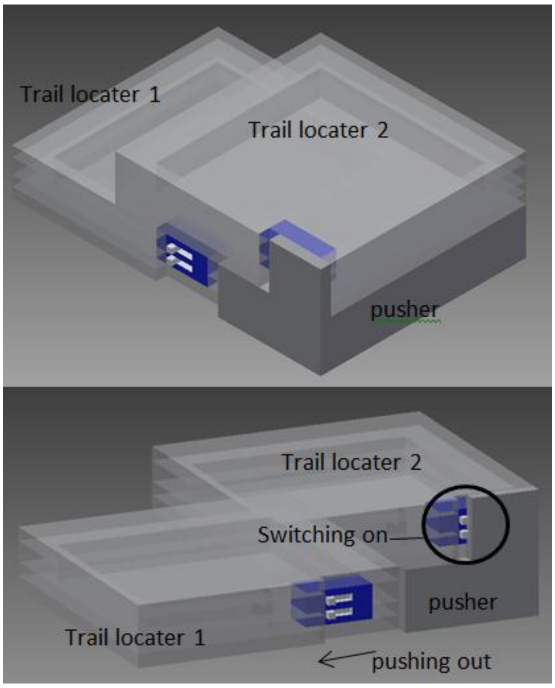

Figure 25: Pushing Mechanism

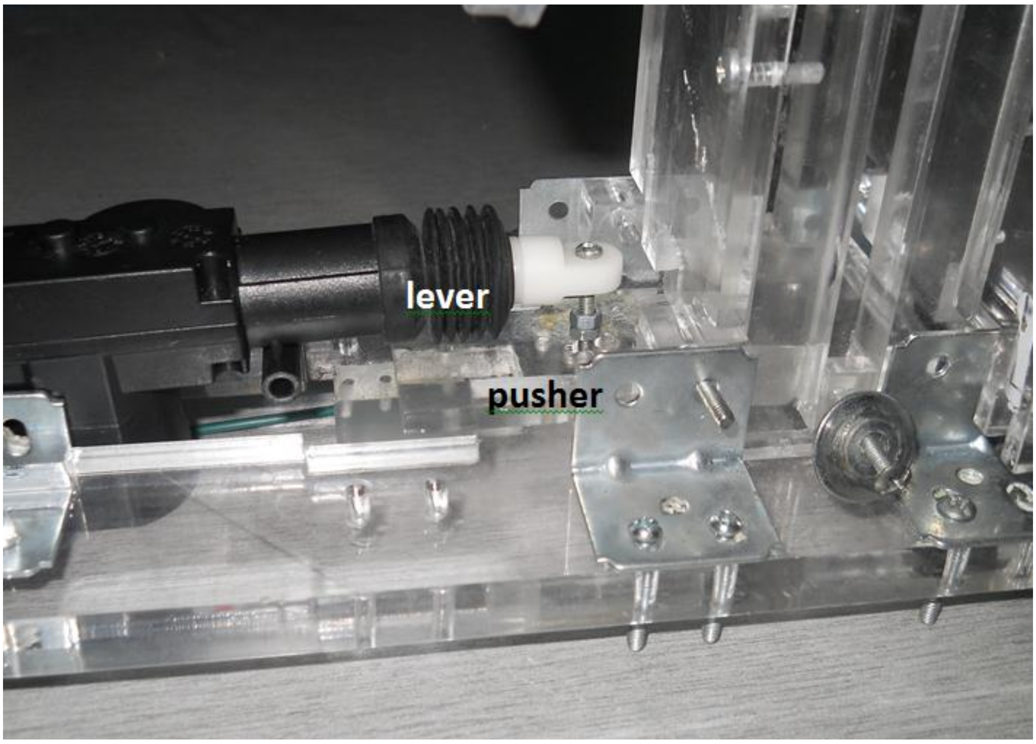

Figure 26: Pusher Attached To the Powerlock Lever

As visualize in Figure 11, there is 2mm gap made for switching in order to switch to ON position as shown in Figure 24. Switching is described as in Figure 25. The pusher is attached to the power lock motor lever as shown in Figure 26. The pusher is made to push trail locater 1 and at the same time switch on trail locater 2.

Figure 19 shows schematic diagram of circuit used to control the motor for pushing mechanism and the real circuit built is shown in Figure 21. Powerlock motor which is widely used in car lock system is chosen as it has sufficient force and the unit is built with combination of gears to produce linear motion. The chosen powerlock motor works as the lever will extend by applying positive voltage and shorten by applying negative voltage. In order to control the motor which is to control extending and shortening of the lever, DPDT relay is suitable to swap the terminal. DPDT relay will swap the terminal as 5v is supplied to the coil. Still, connecting the coil directly to the Programmable Integrated Circuit (PIC) will not work because the output from PIC is 3v. Alternative way is to connect the coil through a transistor as shown in Figure 19. Transistor works by connecting the circuit from collector to emitter by applying voltage to the base. The transistor base will be connected to the PIC output as 3v is sufficient to supply to the transistor.

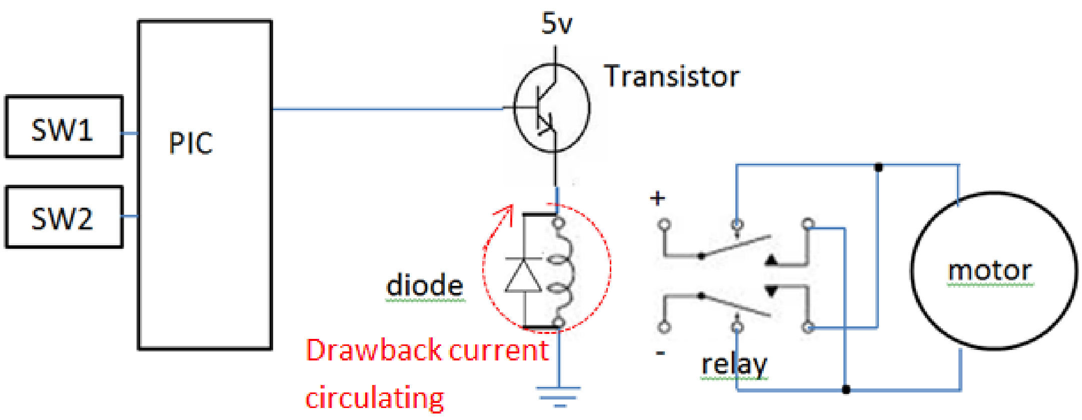

Figure 27: Application of Paralleling Diode to the Coil

Another consideration is to apply diode parallel to the coil as shown in Figure 19. This is to protect the PIC from sinking overcurrent. Overcurrent can happen as the coil drawback current during relay switching. By applying diode, the drawback current will circulate as a loop and will not go to PIC as described in Figure 27.

```
#include <pic.h>
__CONFIG ( 0x3F32 );
#define         relay           RE2
#define         SW1             RB0
#define         SW2             RB1
void delay(unsigned long data);
void main()
{   TRISE = 0b00000000;
   TRISB = 0b11111111;
                relay=0;

while(1)
{relay=0;

if (!SW1)
{               while(1)

                {relay=0;
                                while(!SW2)
                                {   relay=1;delay(200000);relay=0;delay(300000);   }

                                while (SW2)
                                {               if(!SW1)
                                                { relay=1;delay(200000);relay=0;   }
                                }
                }}} }
void delay(unsigned long data) {for( ;data>0;data--);}
```

Figure 28: Coding Used In PIC

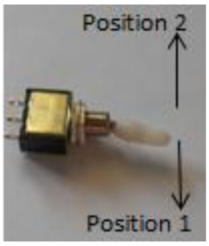

Figure 29: SW 2 at Position 1

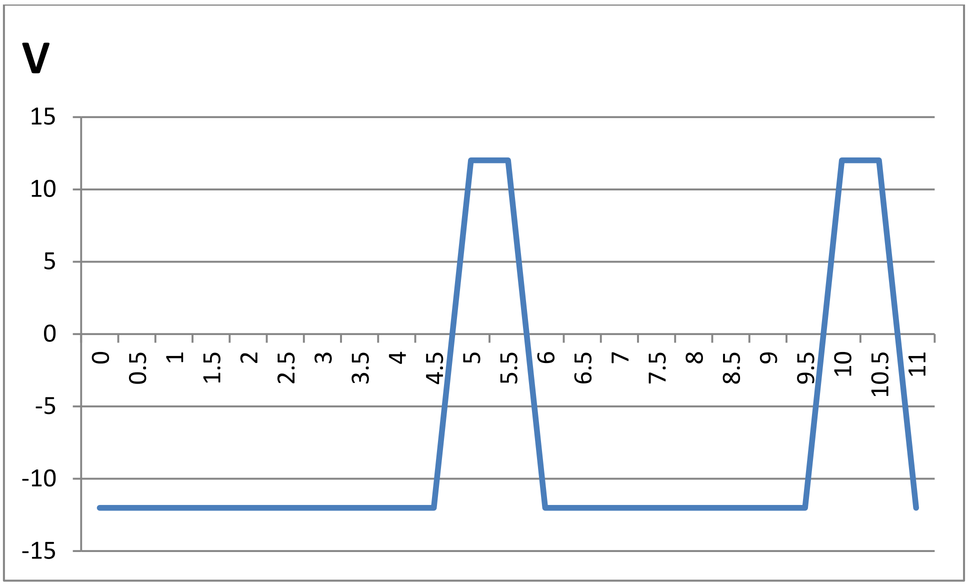

Figure 30: Signal Voltage for Motor Control

The circuit contains two switch; a pushbutton switch, SW1 and a toggle switch, SW2. Refering to Figure 28, the operation programmed is when the SW2 is at position 1 as shown in Figure 29, the motor will operate automatically. The programmed voltage supplied to the motor is shown in Figure 30. When SW2 is at position 2, motor will operate manually. Meaning every dropping is made when SW1 is pressed once.

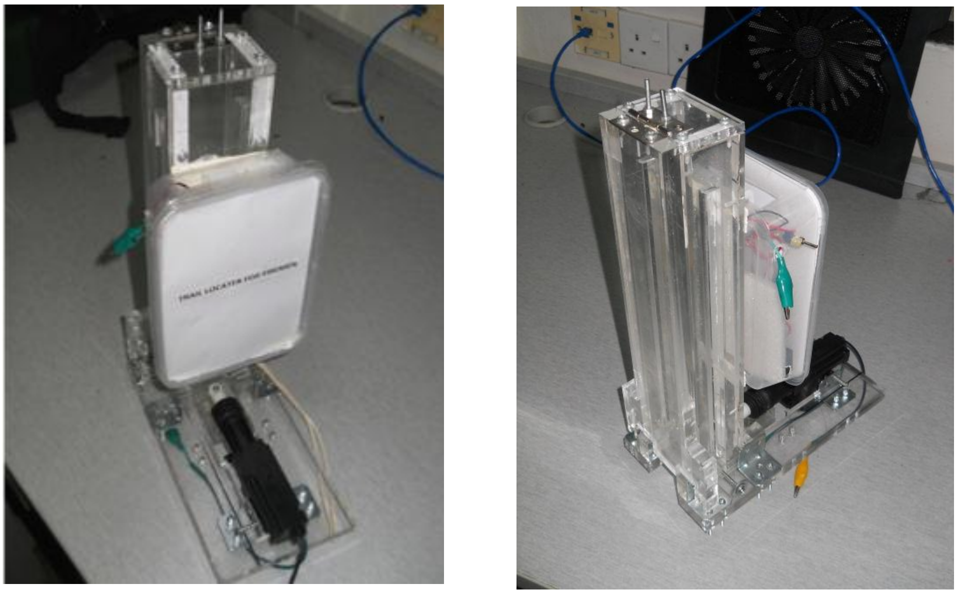

Figure 31: Completed Prototype

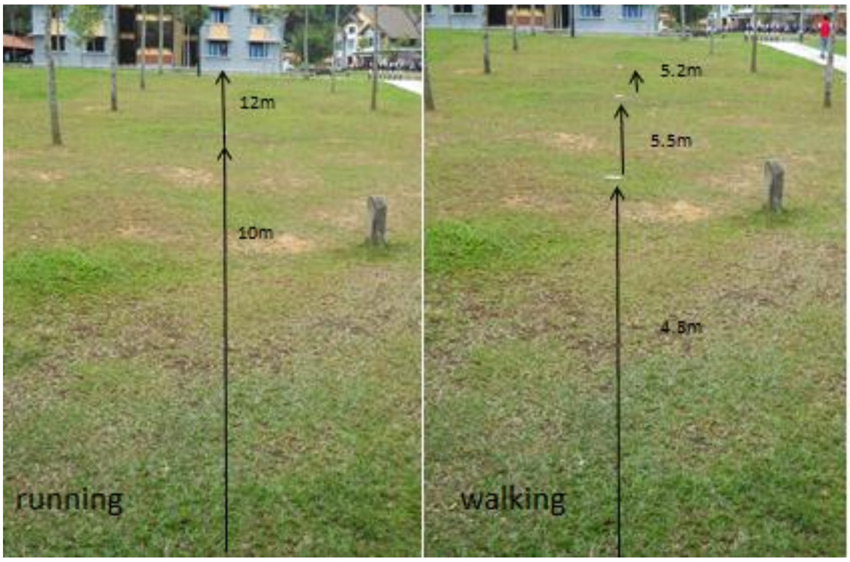

Figure 32: Trail Locaters Dropped

Figure 31 shows the completed prototype made. It was estimated that this prototype can reload the trail locaters up to 20. The prototype was tested. As dropping were set to be 5 second interval, referring to Figure 32, average distance made between each trail locaters dropped while walking is 5m to 6m. While running slowly, the distance made between each locater is more than 10m. The distance between each locater must be closer to provide better trailing. The suggested distance between locaters is about 3m.

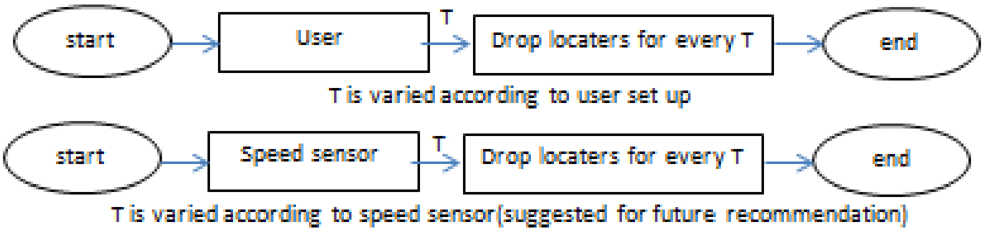

Figure 33: Trail Dropper Flow Chart

As describe in Figure 33, the prototype works as an open loops system which is to drop for every dropping time, T which is set up by user. Thus for future recommendation, the dropping mechanism should be upgraded to more intelligent open loops system. The trail dropper must be able to vary the dropping time, T according to user movement speed detected by speed sensor.

CHAPTER 5
CONCLUSION

As a conclusion, the proposed system is convenient for firemen rescue as the path travelled by firemen is traceable. The traced path can be used to guide toward the firemen current position. Thus efficiency of firemen rescue can be increase compare to conventional method. Firemen trail locater is a user friendly system which makes the firemen rescue operation becomes easier.

As time moves on, for future planning, this project will be embedded with RFID for mapping the path. Experiment performed will be tested in BOMBA laboratory. Standardization will be tested by responsible company such as Standards and Industrial Research Institute of Malaysia.

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