Remote Pressure Level Monitoring For Firemen Using Bluetooth

By

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CERTIFICATION OF APPROVAL

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Approved:

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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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Muhamad Aizat bin Aluwi

ABSTRACT

At present there is no technology used to alert firefighters of oxygen quantity in their tank while doing saving work during fire. If they are not alerted and have no indication on the level of oxygen reserved in their tanks, this may cause fatality to them. Instead of saving people, the firefighters who are lack of oxygen also need to be rescued. The objective of this final year project is to develop RFID based system that will be able to gauge the pressure level of oxygen in the tank and also generate alert to the firefighter when the level is low. This technology offers numerous advantages over the traditional method. In this work, RFID tag with pressure sensor will be attached to the oxygen tank and the reader will be placed at the fire engine. The firemen will carry the tank with RFID tags while doing their rescue work and they will be monitored from the fire engine. The firemen on the fire engine will detect the pressure level of the remaining oxygen in the tank and can send alert whenever it is needed. As for current practice, the level of oxygen remaining in the tank needed to be manually predicted by the fireman. Methodologies of this project are discussed tentatively and will be improved on the project progresses.

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INTRODUCTION

1.1 Background of Study

Radio-frequency identification (RFID) is a promising technology. It is one of the most promptly growing segments in today’s automatic identification data collection (AIDC) industry. Nowadays, this rising technology is not new. Currently, RFID is being applied in various applications throughout the world. Walking down through history, RFID was originally implemented during World War II in order to identify allied planes, using identification system named Identification, Friend or Foe, and is still in used today for the same objectives. [1].

An RFID system has 3 essential elements which are tags, readers and host computers. RFID tags consist of packaged tiny semiconductor chips and miniaturized antennas. RFID tag looks like paper labels applied on boxes and packaging. Other tags embodied into the walls of injection-molded plastic containers [2].

While RFID reader obtains object and surrounding information through communication with tag antennas, readers and tags can respond in a wireless way without being need to connect with any wire and cable. RFID can also identify high speed mobile objects of and certain amount of tags simultaneously via its anti-collision mechanism.

Tag is designed with a unique identifier (ID) which allows wireless tracking on the object or person where tag is embedded to. The chip can hold large amount of data such as serial numbers, time stamps, configuration instructions, technical data, medical records, and travel history.

One of the greatest obstacles to the wide adoption of any new technology is a standardization process. The standardization is to define which industry can operate and advance with the most efficient platform. Several organizations involved in outlining standards for this RFID technology. However, looking at the present status, it seems it will be some time before all of the details are agreed on.

1.2 Problem Statement

- Predicting pressure level of oxygen in the tank during fire gives more burden to the firefighters.
- Traditional method is based on experience and instinct which may be dangerous for fire fighters during rescue mission.
- Currently, there is no method or way to indicate or measure low pressure level of oxygen reserved in the oxygen tank used by firemen.

1.2.1 Problem Identification

The technology used by the firemen today is not up to date and it affect the process of saving people when there is fire occurred. In news report obtained from ctpost.com, two fire fighters, Lt. Steven Velasquez and Michel Baik, were reported died during a routine fire on the West Side city. [9]

The Spokesman from Fire Department Capt. Ed McCann said the State Fire Marshal's office, which was called in for investigation on this incident, has found out that the men’s breathing apparatus unable to determine if there were any problems.

> "They had full equipment on when they went in and we don't know if there was a problem with the equipment or they just ran out of air," he said. "My feeling is that they probably ran out of air, but we won't know until they finish the investigation." McCann explained that the tanks hold between a half-hour to 45 minutes of oxygen. "Sometimes it's longer, sometimes it's shorter, depends on the man and the amount of work he is doing. In a situation like this where it was hot they could have really been gulping the air."[9]

1.2.2 Significant of the Project

This project is an innovative tool to make the process of saving people during fire occurred more reliable without putting the risk of suffocating due to lack of oxygen to the firefighters. The system helps and guides the firemen to measure the quantity of oxygen left during the saving process. The system continuously measure the pressure level of oxygen tank and give certain signal to the firefighters when it is time to refill or change the oxygen tank. Thus, makes the system as real-time locating system (RTLS). The system helps to eliminate the possibilities of miscommunication between firefighters and firemen who are working on the fire engine.

1.3 Objectives of the Project and Scope of Study

The primary objective of this project is to develop a continuous remote system that integrates pressure sensor with RFID technology to measure oxygen level in the tank used by firefighters.

The sub-objectives of this project are;

a) Provide alert (buzzer) to trigger the firefighters if their oxygen level drops below the predefined limit
b) Giving information to the fire engine the pressure level of the oxygen tank

1.4 The Relevancy of the Project

In order to achieve these objectives, a few tasks and research need to be performed by developing the database using Microsoft Visual 2008, MySQL program and hardware of RFID. A recommendation is to be made based on the research and finding of the subject regarding the applicability of the RFID based on gauging pressure of oxygen tank that will be used by firefighters.

1.5 Feasibility of the Project

This project comprise two semesters project such that more research and study will take part in Semester 1 (Part 1) while more modeling, prototyping, and testing part will take part in Semester 2 (Part 2). However, some part of modeling and developing the database and user interface application work can be started during Part 1.

There are two important things that need to be fully understood before starting with the project. They are; understanding of RFID technology and understanding of development platform. Therefore, this project is feasible to be carried out within the provided time and scope.

In term of time frame, the project is feasible to complete integration of RFID device to the tank, VB application, and SQL Server Database. Thus it fulfills the objectives of the project.

CHAPTER 2

LITERATURE REVIEW

2.1 RFID Technology Overview

Generally, RFID simulates a way of identifying objects or people by using radio waves. Identification is made likely via unique identification numbers that will identify object, people, and information. Microchips store all the data which can be read automatically. With the recent development and advancement in RFID technology, the automatic data capture industry is stimulating their effort to identify new applications of RFID [1].

Similar to television and radio, RFID systems operates on four major frequency bands: high frequency (HF), ultrahigh frequency (UHF), low frequency (LF), or microwave bands. Why RFID do operated at different frequency bands? This is because the different frequencies have different propagation characteristics [1]. UHF band is the systems that are coming on the market today and the microwave band is the hot prospect in the future application. The most common method use for RFID is relying on storing and remotely retrieving data which involves the usage of tags, readers that collect data and manage it in a portable, changeable database [3].

Basically, RFID systems are consist of a few principle components and fundamental technologies that can make them work. The first main components of RFID system is RFID tag (transponder) which the data carrier of this system and located on the object to be identified. The second element is reader (transceiver) which able to read and write data to the transponder. The third element is data processing subsystem utilizing the data obtained from the transceiver to useful manner [1]. However, it is must be noted that the operating frequency play a huge role on the functionality of RFID system.

RFID technology allows the data and information to be stored and read wirelessly without requiring the line of sight (LOS). It can read inside a casing, box, or carton and etc. Furthermore, the tags can be read hundreds at a time by the reader which means it can do bulk reading of objects.

When within range of the reader, the tags are “interrogated” by the reader. The reader generates a radio frequency “interrogation” signal and has a receiver which can capture a reply signal from the tags and finally decodes this signal. More detailed description of the system will be followed.

2.2 RFID Tag

There are 3 categories of RFID tag: passive, active and semi passive. These kinds of tags have operating characteristics respectively and the means by which they receive power for transmission determines their type [3].

The passive tags just rely on the operating power from current induces in their antenna through the signal waves generated by the readers to be functional. Therefore, the passive tags only operate at maximum length of 3 meters or less. The simplest of passive tags able to of hold data in the range of 64-bits of factory-written unique data.

Figure 1 : 13.56-MHz RFID tags

The semi passive tags however use battery to run its’ chip circuitry, but communicate by drawing power from the reader [2]. Once triggered by the reader’s signal, these tags utilize their own powers drained from the battery to execute their tasks.

The active tags may be powered by a tiny battery within the tag by an RFID reader that "wakes up" the tag to request a reply when the tag comes within range (passive tags).

Active tags can operate 100 meters or more away with reader. It needs fewer signals from the reader compare to passive tags. Therefore, active tags can contain sensors and data loggers because they are continuously powered. It is suitable to be data loggers since they can support a clock and contain vast amounts of memory.

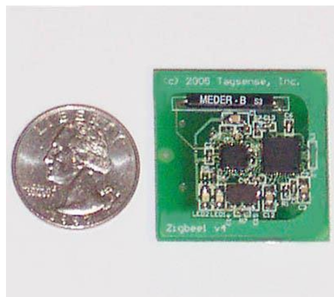

Figure 2 : Active Tag with the scale of coin

There are general RFID tag requirements whose quite importance depend on the application. These requirements define selection criteria to choose RFID tag antenna:

a) Frequency band

   Depends on the country law and standard where the tag will be used.

b) Size and form

   Should it be implanted or just attached to required objects.

c) Read range

   Minimum required read or range is usually specified.

d) Type of Object

   Tag performance varies on different objects. An antenna should be designed for optimal performance on the respective object.

e) Orientation

   Antenna orientation influenced the reader range. The way the tag is attached to the object in sequence to the reader's field polarization will give a significant effect on the communication distance [1]. The orientation can be optimized when two antenna coils (reader and tag) are located parallel to each other. Refer to figure 3 below.

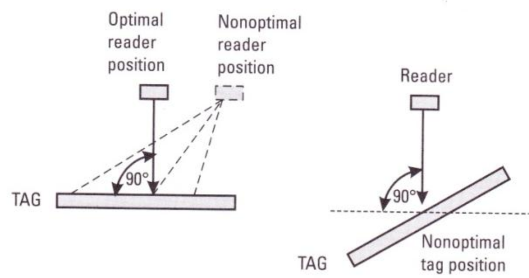

Figure 3 : Optimal and non-optimal tag and reader position

f) Application with mobility

RFID tags can be mobile during operation and it does not affect the operation but it spends less time in the read field. In this case, it will demand a high-read-rate capability for the reader.

g) Cost

In one RFID system, there will be thousands of tag being used. Thus, the low-cost tag device must be in used dictating limitations on antenna structure and choice of construction materials

h) Reliability

Reliable device will sustain variations in temperature, humidity, stress and survive label insertion, printing, and lamination processes [1].

i) Power of the tag

Active tag carries internal battery and has greater range than passive tags. Passive tags rely on the reader for power to be functional, while semi passive tags rely on the reader to empower transmission but the internal battery to power their own circuitry.

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

a) Data Capacity

As for example, a library tags typically have space for 256 bits of information which is more than adequate 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 traditional 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 it is needed. However, not all type of tags has this feature.

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 can decipher and read the data from the encrypted tag.

d) RTF versus TTF

All RFID readers transmit constant signal that can power up the RFID tags that are within the range. In a system where the ‘reader talks first’ (RTF), the reader will transmit a second command signal that request the data from the tags. As a result, the tags response to the second signal from the reader and start sending identifier and pertinent data it stores from the reader [3]. While in the ‘tag talk first’ (TTF) event, the tags straight away reply to the reader’s signal without requiring the reader to transmit second command signal as in RTF.

2.3 RFID Readers

The term “reader” or interrogator is a misnomer [4]. Technically, reader units consist of transmitter and receiver. However, since their role to request tag signal and receive information from it, reader are seen as “reading the tag”. Reader may be portable handheld terminals. It also can be a fixed device positioned at strategic points, such as entrance, assembly line, or toll booth. It is installed with antennas to send and receive signals and a processor for data decoding [1].

The reader extracts data from the tag and it may be self-contained and record the information internally. However, it can also be part of a localized system such as Local Area Network (LAN) or Wide Area Network (WAN). For this operation, the reader includes an RF transmission to receive and decode data. Moreover, the reader often accommodates a serial communication (RS-232, USB and so on) capability to communicate with a host computer [1].

RFID readers consist of an antenna to communicate with the tags and an electronics module that is networked to the host computer. The module relays messages between the host computer and all the tags within the antenna’s read range, enabling one reader to communicate with hundreds of tags simultaneously.

Basically, depend on its mobility; there are two types of RFID readers:

a) Fixed RFID reader

   Reader read the tags in a stationary position and it is setup in respective interrogation zones and creates a “bubble” of RF energy which can be tightly controlled.

b) Mobile RFID reader

   Reader is mobile when reading the tags. Mobile reader includes handhelds reader and vehicle mounted RFID readers.

2.4 Host Computer

The host computer is very essential in any RFID system. It can take the shape of a personal computer (PC), laptop, server or a workstation as long as they run database and control software. The host computer is the brain of the RFID system and every information's collected from the tags are processed by the host [5]. The RFID reader will cross-reference the tag's data within its self-contained database. After the reader receives new data, it will send the data to the host. The readers and the host communicate through a secure wireless link.

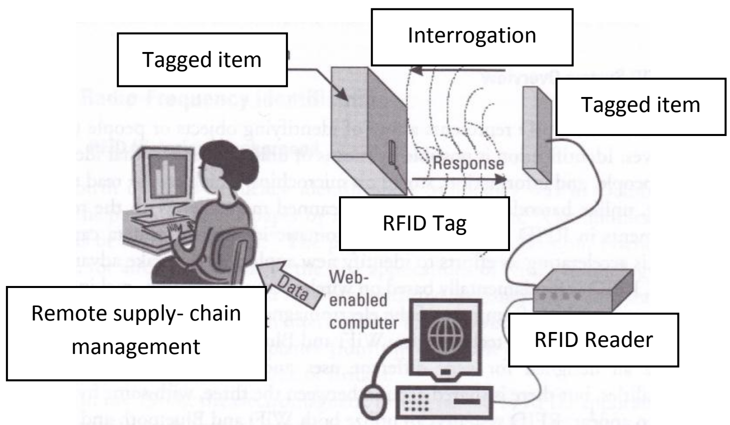

Figure 4 : Basic components of an RFID system

2.5 Operating Frequency

Different RFID systems operate at a variety of radio frequencies. Each range of frequencies offers its own operating range, power requirements, and performance. Different range may be subject to different regulations or restrictions that limit what application they can be used for.

Operating frequency is also important in determining the physical dimensions of the RFID tag. Different sizes and shapes of antennas will operate at different frequencies. Other than that, the operating frequencies also determine how tags physically communicate with each other. For instance, stacking flat foil inlay tags on top of each other may interfere or prevent tags from reading properly [6].

RFID operates in unlicensed spectrum space, sometimes referred to as ISM (Industrial, Scientific, and Medical) but the exact frequencies that constitute ISM may vary depending on the rules and regulations in different countries. These operating frequencies are generally considered to be organized into four main frequency bands and the table shows these different radio waves bands and the common frequencies uses for RFID systems (IEEE, 2005).

Table 1: RFID operating frequencies and associated characteristics

Band	**Low Frequency** **(LF)**	**High Frequency** **(HF)**	**Ultra High Frequency** **(UHF)**	**Microwave**
Frequency	30-300kHz	3-30MHz	300 MHz-3GHz	2-30 GHz
Typical RFID Frequencies	125-134kHz	13.56 MHz	433 MHz or 865-956 MHz	2.45 GHz
Approximate read range	Less than 0.5 meter	Up to 1.5 meters	433 MHz = up to 100 meters 865-956 MHz = up to 3 meters	Up to 10 meters
Typical data transfer rate	Less than 1 kilobit per second (kbps)	Approximately 25 kbps	433 - 956 MHz = 30 kbps	Up to 100 kbps
Characteristics	Short range, low data transfer rate, penetrates water but not metal	Higher ranges, reasonable data rate (similar to ISM phone), penetrates water but not metal	Long ranges, high data transfer rate, concurrent read of <100 items, cannot penetrate water or wall.	Long range, high data transfer rate, cannot penetrate water or wall.
Typical Use	Animal ID Car Immobilizer	Smart Labels Contact-less travel cards Access and Security	Specialist animal tracking Logistic	Moving vehicle toll

2.6 Principle of RFID Operation

The coupling between tag and reader is achieved in one of two ways depending on the carrier frequency used and the system antenna design. In these systems the field is effectively tied to its source and the field that couples with the tag is modulated by means of the tag circuitry, such that the data-related changes can be sensed by the reader [1]. Basically, the principle of RFID operation has two basic ways of exchanging information which are:

a) Inductive Coupling and Load Modulation

Inductive coupling means that the tag and the reader's antenna are coupled by the magnetic flux through both coils. The tag draws energy from magnetic field when placed within the alternating magnetic field created by the reader. In load modulation the carrier signal is modulated by switching impedance from a matched condition to an unmatched condition to alter the reflection coefficient [1]. The system is based on a transformer-type coupling between reader's primary coil and the transponder's secondary coil.

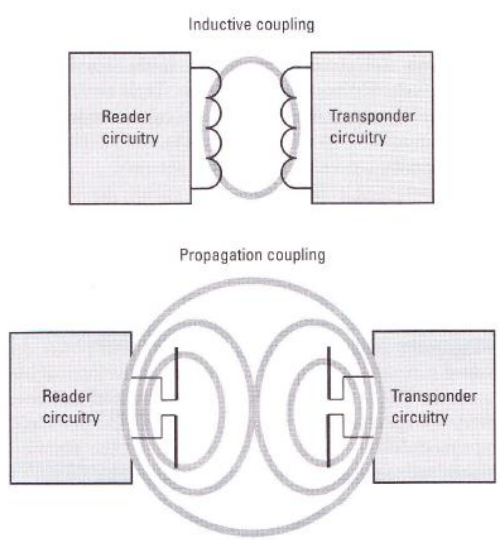

Figure 5 : Inductive and propagation coupling RFID systems

b) Propagation Coupling and Backscatter Modulation

The term backscatter modulation refers to the RFID tag communication method to send data back to the reader [1]. The transponder radiates power into free space. The readers' antenna will pick up this free attenuation. The reflected signal travels in backward into readers' antenna connection and can be decoupled using a directional coupler.

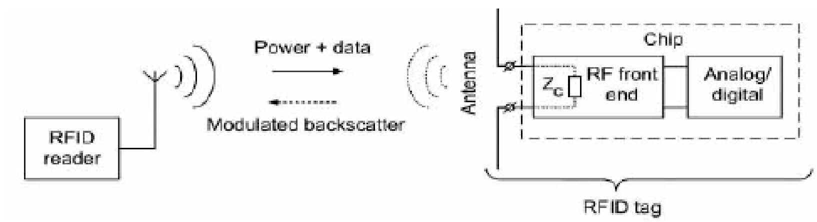

Figure 6 : Backscatter modulation

2.7 Examples of RFID applications

Medication monitoring

The RFID integrated scheme and sensors for in-home medication monitoring was developed by Ho et al. [10]. The function of the system is to monitor the medicine quantity required by elder patient and to assist them to take the accurate amount of medicine as an extension of the Caregiver's prototype by Intel labs. The system is composed of an HF RFID reader, a UHF RFID reader, a weight scale, a base station, and three modes. HF RFID tags are placed on each medicine bottle in order identify each bottle, while the HF RFID reader is used to monitor the location of the medicine bottles within its range. The movement or replacement of a bottle is detected by regular reads on a readers' range. On the medicine bottles, a weight scale combined with RFID tags is used to determine how much of the medicine was consumed by the patient. Each patient also bears an RFID tag and will be notified by sound or light alarm by the associated RFID reader to take the required medicine. This prototype is an advancement of the approach proposed by Intel Labs [11], where a HF RFID reader and tags are used along with two sensor nodes in order to monitor a patient's intake of medicines.

University hospital of Ghent in Belgium implemented an RFID-based Real Time Locating System (RTLS) to provide nurses and other caregivers with location of patients' during emergency events [12]. The system detects when a patient is having cardiac distress, it will send to the caregivers an alert and indicate the patient's location. In the proposed prototype Aero Scout T2 active Wi-Fi tags are used, which transmit the tags' unique IDs to the hospitals Wi-Fi network.

Tracking Patient in Hospital

Based on the products of Visonic Technologies (VT) which is Elpas Wandering Patients Protection Solutions, it is designed to reduce the cost of supervising ambulatory at-risk patients without excessively restricting their mobile independence. It offers free movement of care givers, guests, other patients or family members and prevents acute patients from leaving monitored areas without proper un-supervision [7].

Based on the products of Visonic Technologies the three major components that are essential for tracking of patients systems are;

a) Positioning Tag

The Elpas Healthcare Positioning Tag is an Active RFID wristband. It provides an effective cost containment and risk management tool for acute care hospitals, geriatric care clinics and long-term nursing care facilities.

The tag's onboard RF/R dual technology transmitter emits low power RF (433 MHz) messages. This data enables the real-time visibility of medical personnel or patients down to bed-level precision without Electromagnetic Interference (EMI) to medical equipment.

Figure 7: Positioning tag with reusable wristband and buckle

Figure 8 : Positioning tag with reusable wristband and lock

b) Receiving Antenna (Reader)

The Elpas RF Bus Reader supervises 433MHz fixed indoor RTLS receiver. The readers' functioned to detect and relay real-time 'Location' and 'State' data from Elpas Active RFID Tags to Elpas Safety and Security software platforms or other hospital management systems.

The reader supports standard IT network communication and is easy to integrate onto wired and wireless Ethernet Wi-Fi networks for relaying data to and from host computer. It supports large tag populations at read-range up to 20m/65ft (360° coverage area) in open room environments.

The antenna or readers are placed strategically array throughout the facility to create blanket RF coverage. The readers will capture a passing patient's positioning tag ID number and transmit that number to the back-end system. Nurses and doctors can access the information regarding the patient's status on their PDAs.

Figure 9 : Elpas RF BUS Reader-Ceiling Mount

Figure 10 : Elpas RF BUS Reader- Wall Mount

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c) Network of host computers

System will provide real-time tracking and can be monitored by a network of computers employing system software and database. If the patient enters the dangerous zone, the alarm will be triggered and the staffs will receive the alert through the network of host computers.

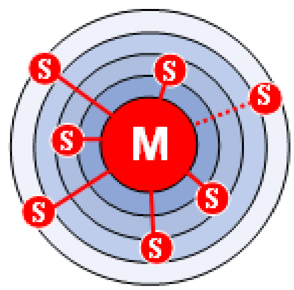
2.8 Software Based Application

The software based applications contain user interface (UI) and database used on the specifications of a particular project that uses RFID. RF readers are connected to computers that run the application to provide input data to be interpreted by the software. With the application of software, RFID makes a complete system.

2.9 Principle of Bluetooth Operation

2.9.1 Communication principle

The Bluetooth standard is basis is a master/slave mode of operation. The term "**piconet**" refers to the network produced by one device and all devices found within its range. A single coverage area can coexist up to 10 piconets. A master can be connected to as many as 7 active slave devices (255 when in *parked* mode) simultaneously. Devices in a piconet have 3 bits logical address, for a maximum of 8 devices. Parked mode devices are synchronised, but they have no physical address in the piconet.



Nowadays, only single slave can be connected to the master device. Therefore, slaves are quickly switched in order to make it seem slave devices are connected simultaneously. Bluetooth enables two piconets to be linked to one another in order to form a wider network, called a "**scatternet**", using certain devices which act as a bridge between the two piconets.

Two piconets can be linked together using certain devices that act as bridge between both piconets. The network is called scatternet.

2.9.2 Constructing connections

In order to connect two Bluetooth devices, there are procedures to be followed as listed below:

- Passive mode
- Inquiry: Finding access points
- Paging: Synchronizing with access points
- Access point service discovery
- Creating a channel with access point
- Pairing using PIN (security)
- Using the network

Device act as "listener" in normal use called as "passive mode". Inquiry is the phase where establishing connection begins. The master device will send an inquiry request to all devices found within its range (*access points)*. The devices which receive the query reply with their address.

The master device will choose the address and synchronises or paging with the access point. This involves clock and frequency synchronizing with the access point. A link with the access point is then established, to allow the master device entering the access point **service discovery** phase via SDP (*Service Discovery Protocol*). Towards the end, this service discovery phase, the master device is ready to create a **communication channel** with the access point, using *L2CAP*.

To provide a virtual serial port, additional channel RFCOMM operating over L2CAP channel may be established, depends on service needed. However, some applications have been designed to connect to a standard port, independent of the hardware used. For example, certain highway navigation programs have been designed to connect to any GPS Bluetooth device (GPS stands for *Global Positioning System*, a satellite-based geolocation system for finding the geographic coordinates of a mobile device or vehicle)[12].

The access point may include a security mechanism called **pairing**. It provide protection by restrict access to authorised personnel only. Pairing is done with an encryption key commonly known as a "PIN" (*PIN* stands for *Personal Information Number*). In order to make it happened; the access point will send a pairing request to the master device. This may prompt the user to enter the access point's PIN. If the PIN received is correct, the connection will be made [12].

In secure mode, the PIN will be sent encrypted, using a second key, in order to prevent the signal from being compromised. When the pairing becomes active, the master device is free to use the communication channel thereby established.

2.9.3 Bluetooth profiles

The Bluetooth standard defines a certain number of application profiles (called *Bluetooth profiles*) in order to define which kinds of services are offered by a Bluetooth device. Thus, each device can support multiple profiles. Here is a list of the main Bluetooth profiles:

- Advanced Audio Distribution Profile (A2DP)
- Audio Video Remote Control Profile (AVRCP)
- Basic Imaging Profile (BIP)
- Basic Printing Profile (BPP)
- Cordless Telephony Profile (CTP)
- Dial-up Networking Profile (DUNP)
- Fax Profile (FAX)
- File Transfer Profile (FTP)
- Generic Access Profile (GAP)
- Generic Object Exchange Profile (GOEP)
- Hardcopy Cable Replacement Profile (HCRP)
- Hands-Free Profile (HFP)
- Human Interface Device Profile (HID)
- Headset Profile (HSP)
- Intercom Profile (IP)
- LAN Access Profile (LAP)
- Object Push Profile (OPP)
- Personal Area Networking Profile (PAN)
- SIM Access Profile (SAP)
- Service Discovery Application Profile (SDAP)
- Synchronization Profile (SP): used to synchronise the device with a personal information manager (or *PIM* for short).
- Serial Port Profile (SPP)

CHAPTER 3

METHODOLOGY

3.1 Experiment Methodology

For Part 2 of the Final Year Project (FYP), the author will focus more on how to achieve the objectives of this project successfully. The author already identifies and analyzed the problem after starting the project. One of the major issues that arise is about the RFID module that integrated with pressure sensor. Although we can find various kind of RFID module integrated with temperature sensor, it differs for pressure sensor. There is no integrated module that can be used for this project. So for the proof of concept, the author will replace the RFID module with Bluetooth module.

Another issue that arises is about the pressure sensor itself. For the sake of testing and demonstration, the author will be using varible resistor to adjust the voltage. The variable resistor will give the output as voltage and be shown in computer in Bar. Replacing the pressure sensor or transducer with varible resistor saves a lot of money because the measuring sensor is too costly.

Developing software and interfaces that starts from FYP 1 really helps the author to ensure the project is right on track. The software development phase started at the Part 1 of this project because it takes a lot of time to develop the software. It must be noted that the author main focus of this project is to develop the RFID system which is the development of the software.

3.2 Project Flow Chart

The rough idea on how the project flow and development phase is shown in the flow chart below.

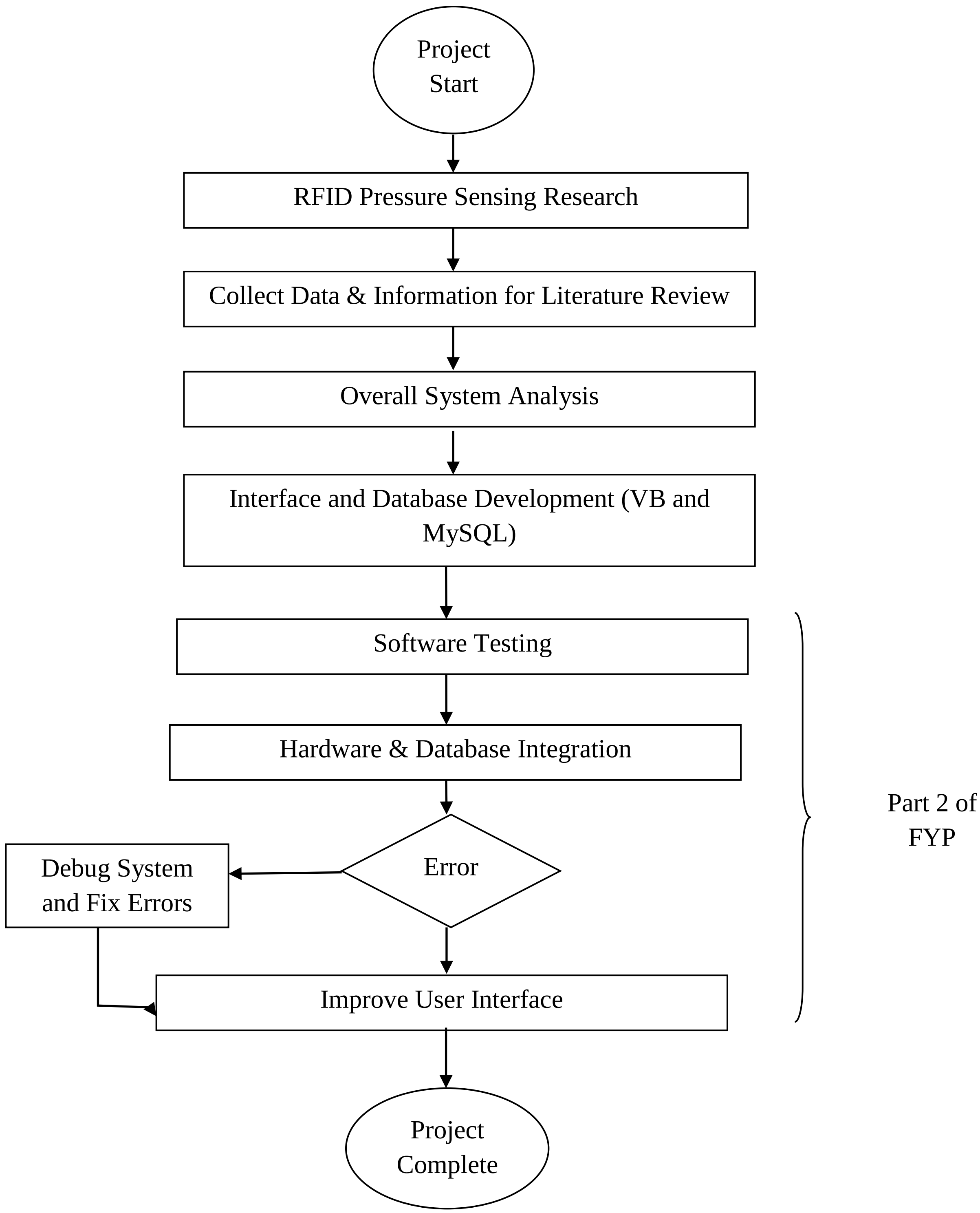


Figure 11 : Project Flow Chart

3.3 Software Required

For the development of the RFID system, the software required are Microsoft Visual 2008 and MYSQL data basing program. MySQL is the perfect platform to develop the database because MySQL is open source which means it is free. Furthermore, it is easily installed at any operating system includes Windows and LINUX. Meanwhile, Microsoft Visual 2008 will provide user-friendly environment for the user to use the system. As for coding the PIC, the author use MicroC as it is the simplest software for beginner. The coding is as attached in the appendix.

3.4 Project Duration

In order to effectively monitor the progress of this project, the Gantt Charts consists of Part 2 of this project has been constructed. Please see the Appendix A.

3.5 Progress in pictures.

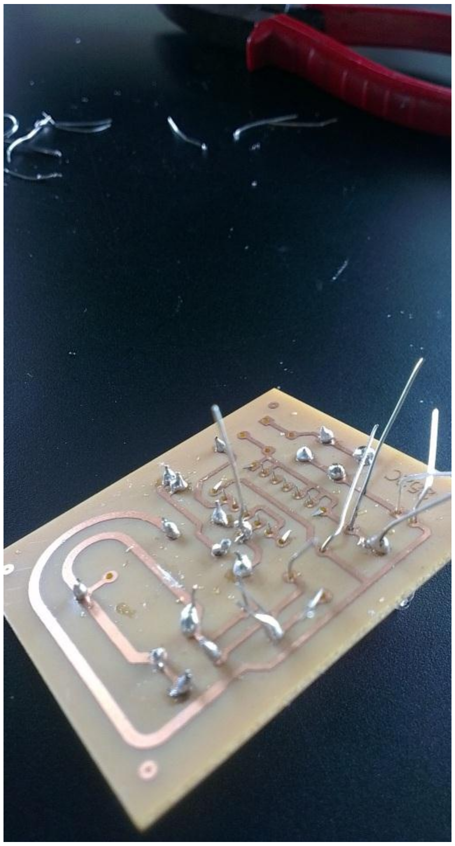


Figure 13 : Printed circuit board

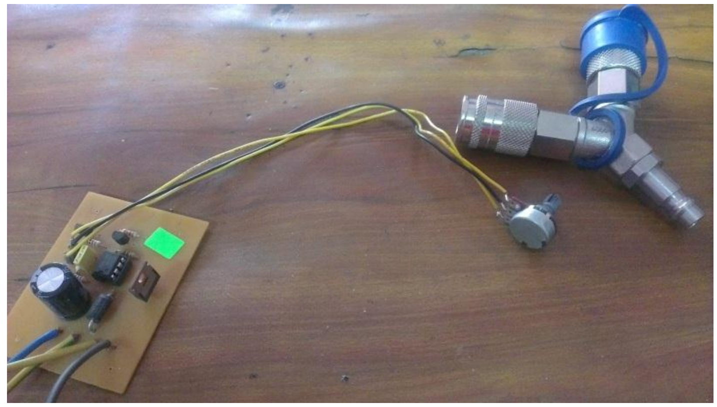


Figure 12 : Replacing pressure sensor that should be connected to the Y connector with variable resistor

Figure 134 : Succesfully working printed circuit board

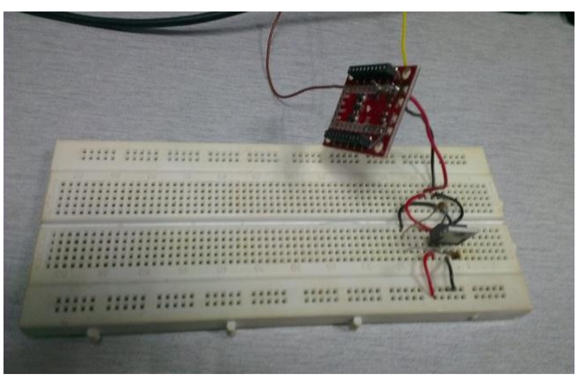


Figure 15 : Bluetooth Transmitter module

Figure 16 : Bluetooth receiver module

Figure 157 : Variable resistor with transducer

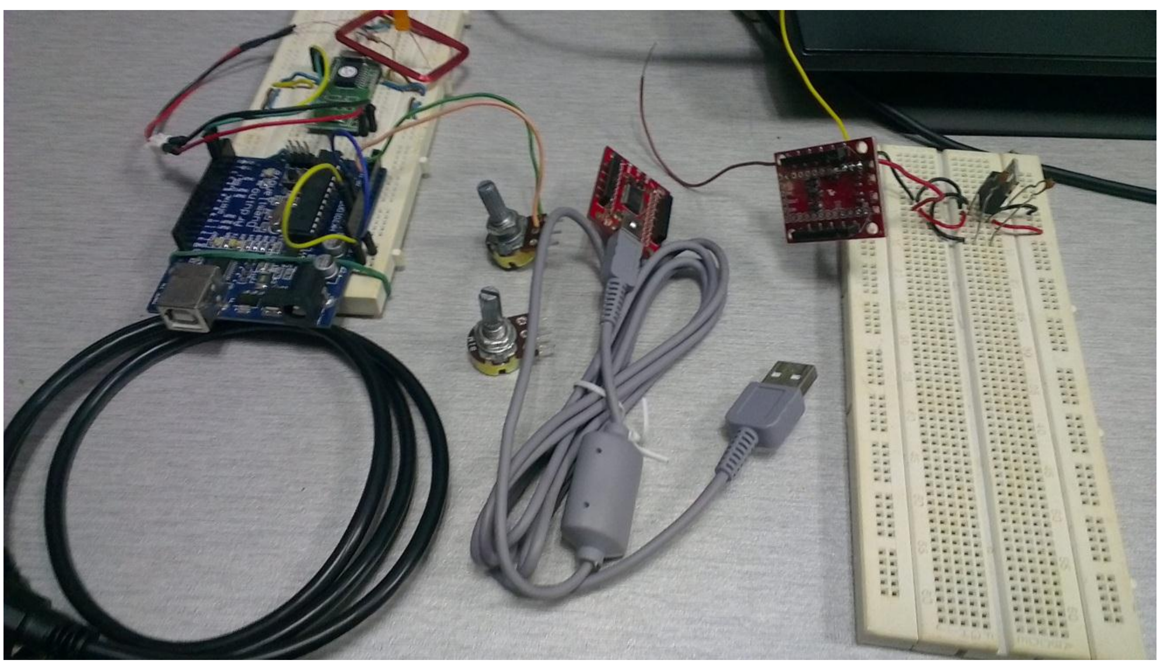


Figure 148 : Testing circuit

3.6 Finalized Design and Schematic Diagram

Figure 19: Bluetooth Receiver

Figure 20: Bluetooth Transmitter

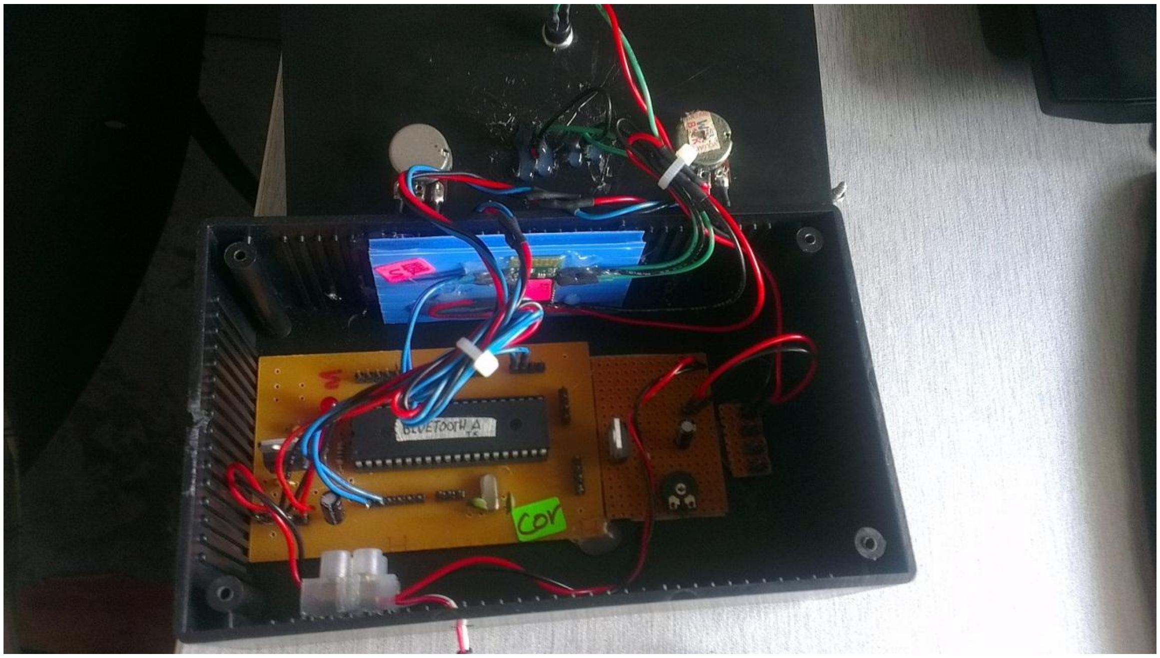


Figure 21: Circuit of the transmitter

Figure 22 : Overall circuit

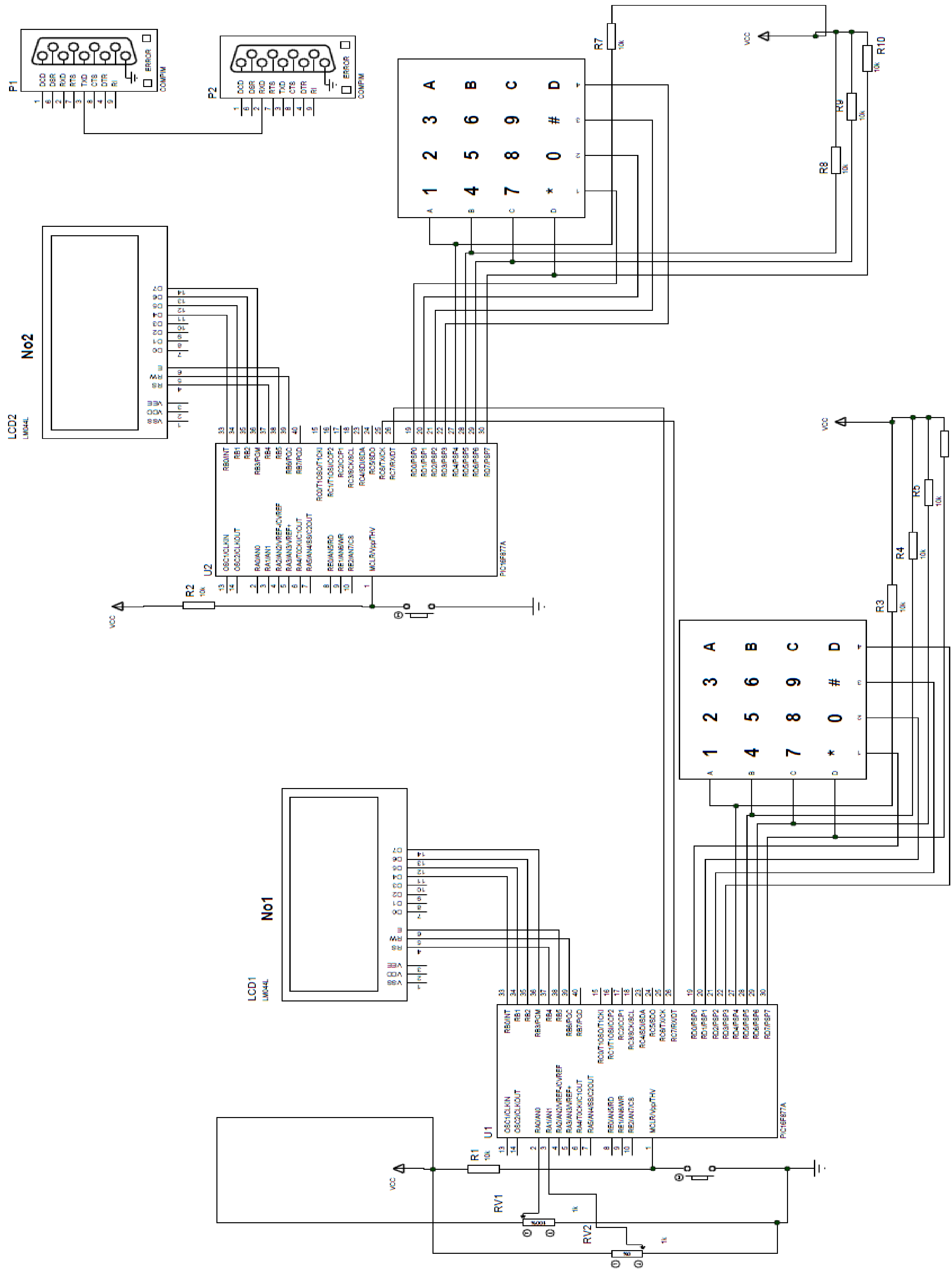


Figure 23: Schematic Diagram of the circuit

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Bluetooth Replacement for RFID

Bluetooth

The Bluetooth wireless specification includes radio frequency, link layer and application layer definitions for product developers for data, voice and content-centric applications. The specification documentation contains the information necessary to ensure that diverse devices supporting the Bluetooth wireless technology can communicate with each other worldwide [10].

The document is divided into two sections:

i) Core Specification (Volume I) - which defines the base technology - and
ii) Profile Definitions (Volume II) - which defines specific usage of the base technology to support specific applications whilst ensuring interoperability between products developed by different manufacturers.

The author is using Bluetooth in this project replacing RFID because the RFID module is not available in the market yet. For testing purpose, the author also will replace pressure transducer with variable resistor.

4.2 Interface

4.2.1 Interface for System Login and Main Menu

The first step, user such as the fireman at the fire engine needs to login their username and password as in Figure 12 below. After the users succeed with the 'Login', 'Main Menu' will come up as Figure 13. The user can choose to click either 'System Administration' to register a new tank of the system or new fire fighter, 'View Tank Record' to view specific tank and 'Pressure Record' to view any tank's pressure at specific time.

Figure 24: Login Menu

Figure 25: Main Menu

4.2.2 *Interface for Administration*

For administrator to register new tank or new user for the system, they just have to click 'System Administration' in Main Menu. This can be seen as in Figure 14 below. If they click on 'Add User', interface as in Figure 15 will come out while Figure 16 will come out if they click 'Add Tank. They just need to complete the form and click 'Submit' and then all of the information will be kept in database of the system.

Figure 27: Administration Menu

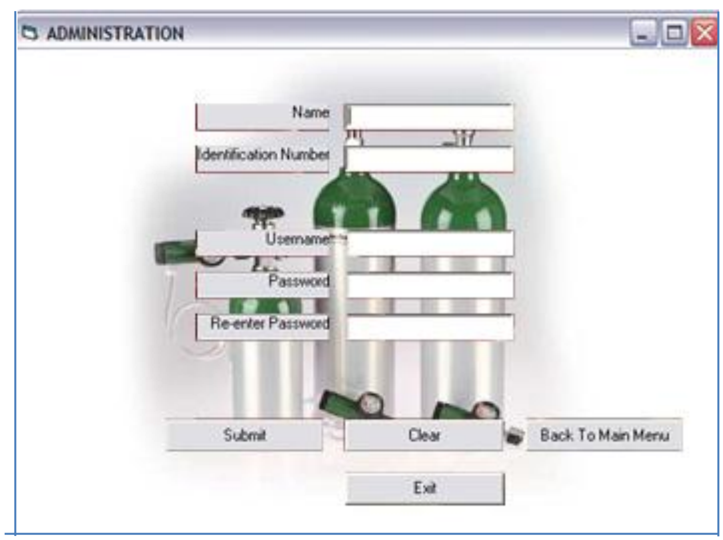


Figure 28: New User Registration Menu

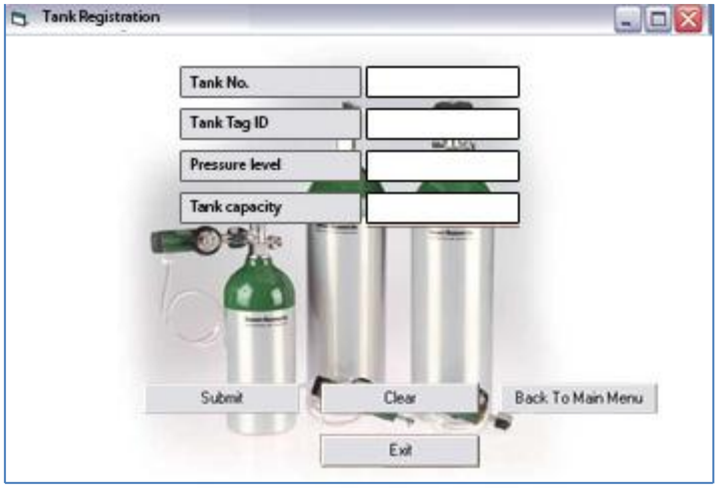


Figure 29: New Tank Registration Menu

4.4 Hardware

Figure 30: Bluetooth receiver

Figure 31: Bluetooth transmitter

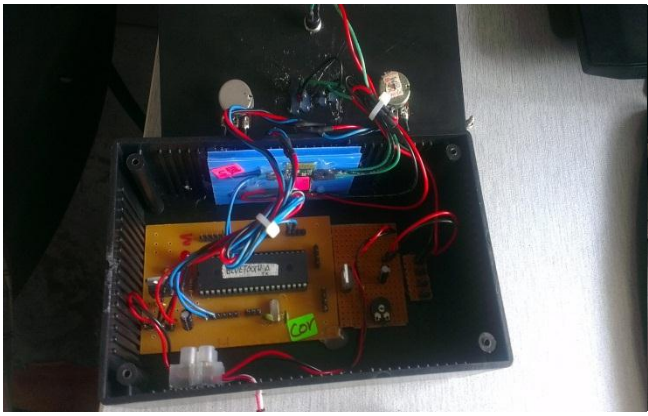


Figure 32: Transmitter Circuit

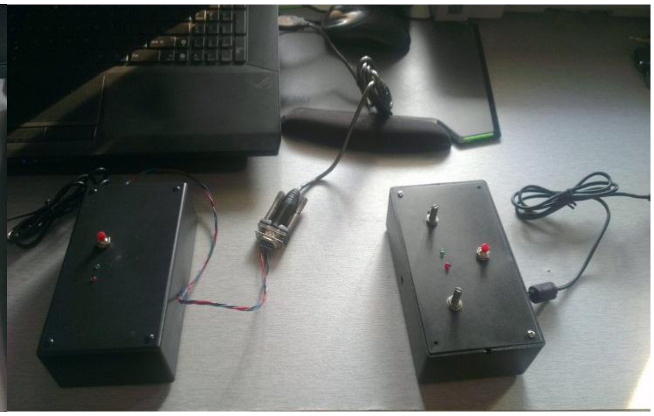


Figure 33: Overall Hardware system

4.5 Testing the Device

4.5.1 Range between each tag and each reader

This test needs to be done to check if any interference happened between each tag and reader that affects the efficiency of the system to send and receive the signal. If interference happened, it can defect the system where maybe the tag cannot send the signal to the reader although it has been triggered by the pressure of the tank.

4.5.2 Time taken from the trigger time until message being send

This system has to be a fast system to make it efficient for the firefighters to take their action during rescue mission. So, the response time of the system must be tune when it will be implemented.

4.5.3 Environment affect

The system should also be tested in rescue environment. It is vital to check whether environment such as space and wall of the building affect the signal send from the tag to the reader.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

For this project, we can conclude that this project is a systematic way to monitor the oxygen level in the tank during rescue. Furthermore, it will enhance confidence level to the firefighters during their job. Stress and panic looking out for oxygen level while saving people can be avoided. Thus, the possibilities of firefighters die due to lack of oxygen can be reduce.

5.2 Recommendations

There are few of recommendations that can be done to improve this system better. They are as follows;

- Gives reading on the oxygen left in the tank used by firefighters
- Alert the fire fighters with buzzer when the tank needs to be refill or replace.

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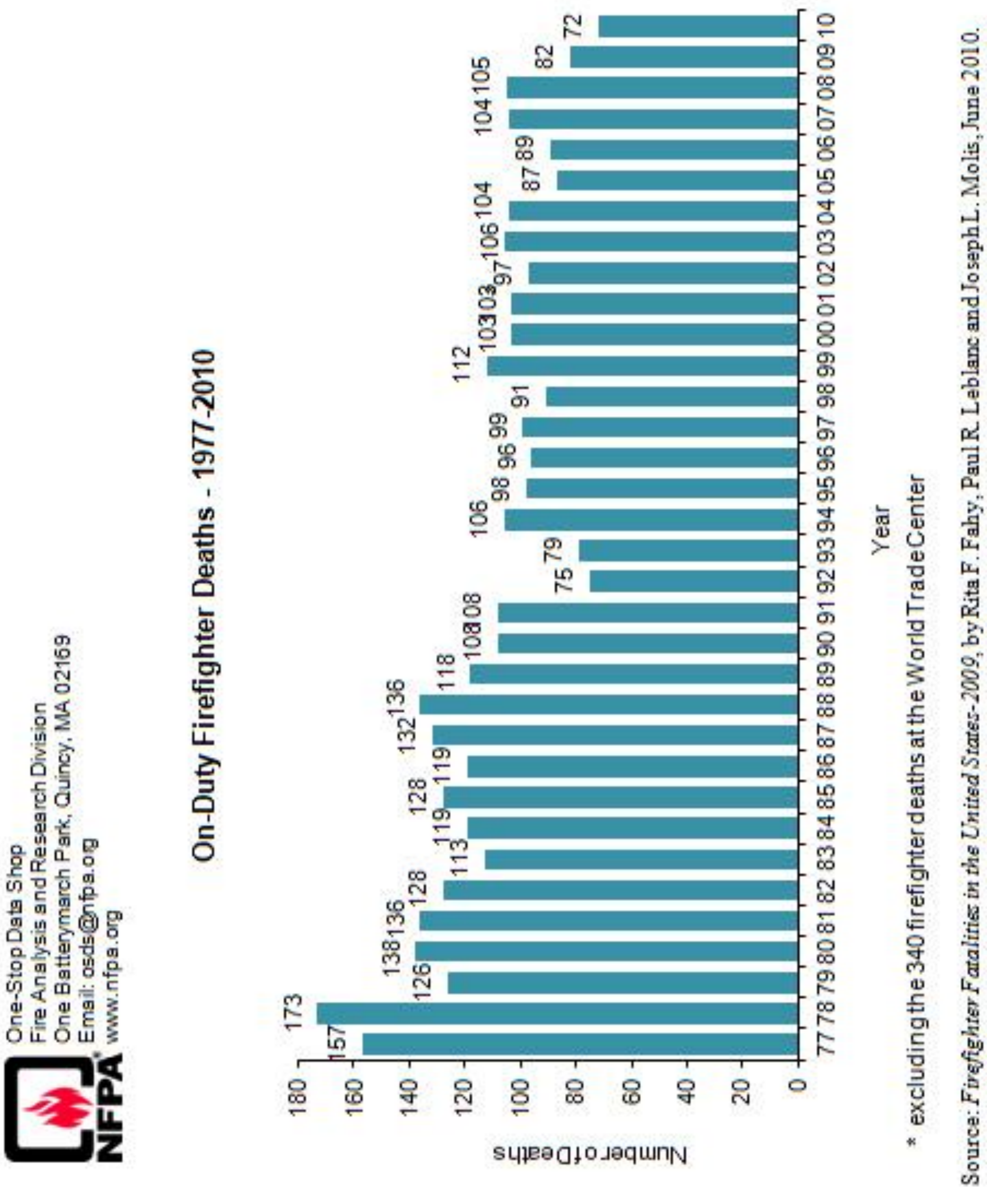
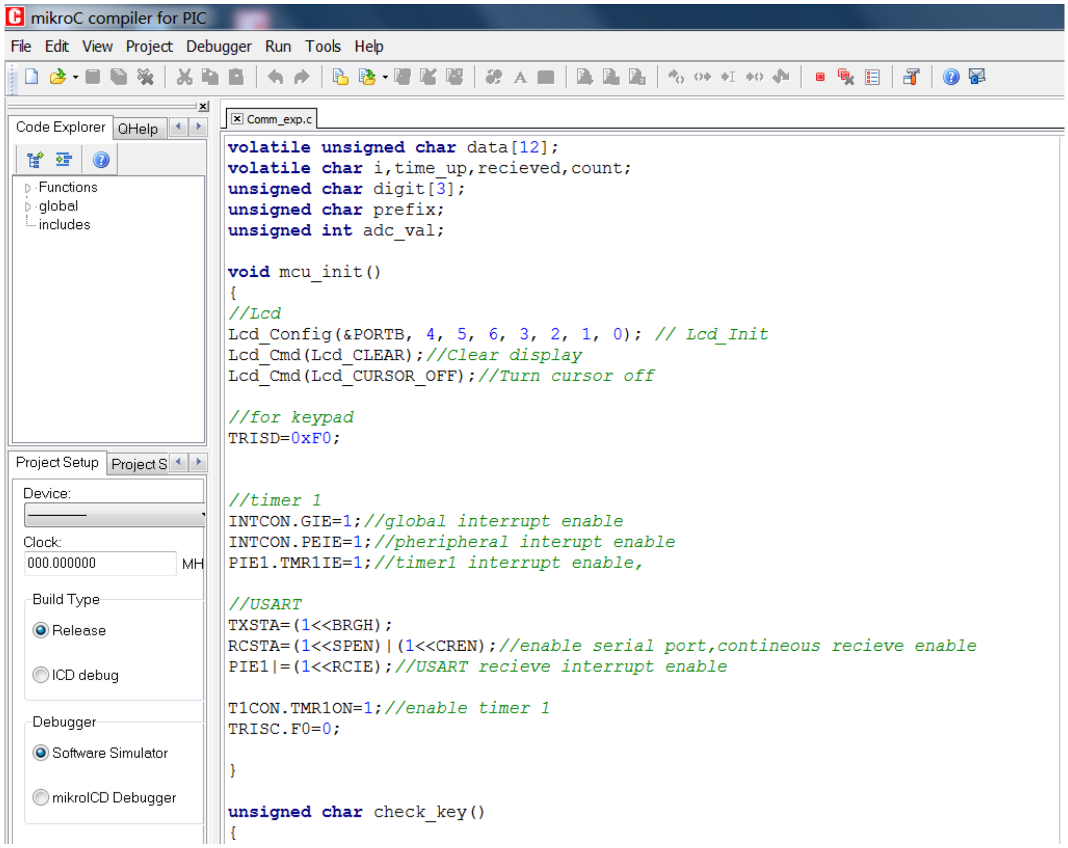
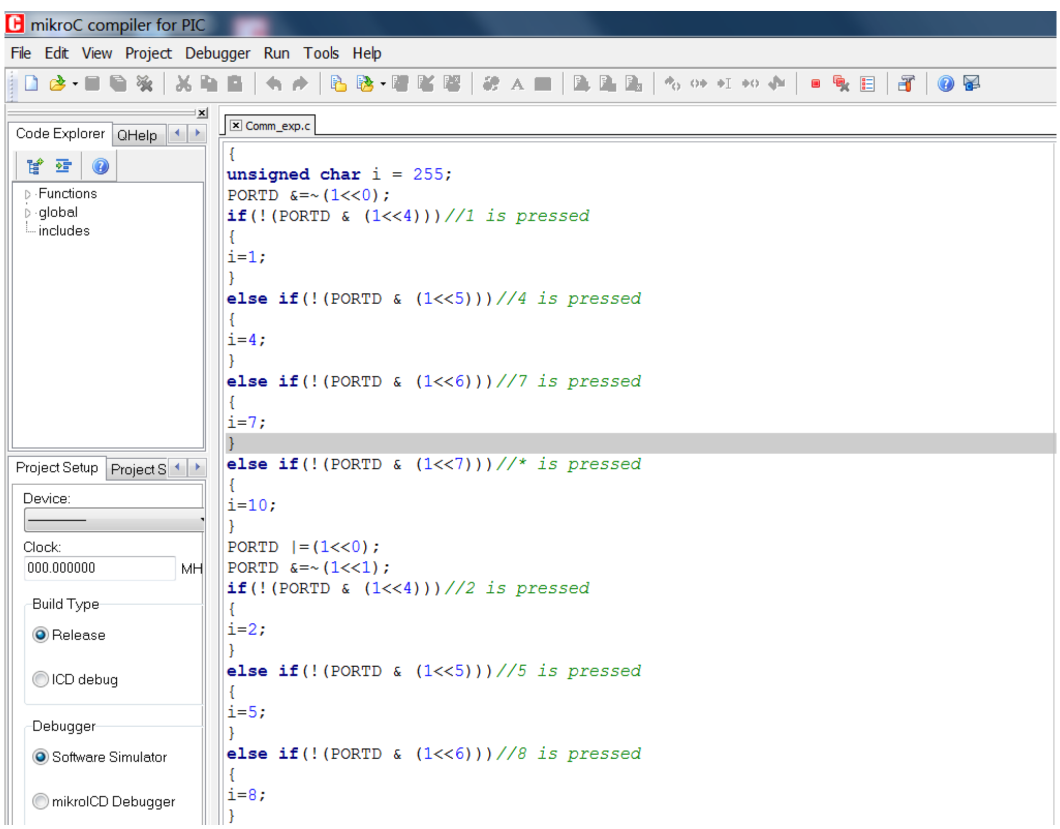
Appendix


One-Stop Data Shop
Fire Analysis and Research Division
One Batterymarch Park, Quincy, MA 02169
Email: osds@nfpa.org
www.nfpa.org
NFPA
On-Duty Firefighter Deaths - 1977-2010
Number of Deaths
180
160
140
120
100
80
60
40
20
0
157
173
126
138
136
128
113
119
128
119
132
136
118
108
108
75
79
106
98
96
99
91
112
103
103
97
106
104
87
89
104
105
82
72
77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10
Year
* excluding the 340 firefighter deaths at the World Trade Center
Source: *Firefighter Fatalities in the United States-2009*, by Rita F. Fahy, Paul R. LeBlanc and Joseph L. Molis, June 2010.

Activities	FINAL YEAR PROJECT 2 (FYP 2)													
	WEEK													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Buy Component														
Start Experimant														
Literature Review														
Communicate hardware and														
Gather More Data and Information														
Testing														
Learn about MySQL														
Develop the Database														
Submisson of Final Draft Report														
Submission of Final Report														


mikroC compiler for PIC
File Edit View Project Debugger Run Tools Help
Code Explorer QHelp
Functions
global
includes
Project Setup Project S
Device:
Clock:
000.000000 MH
Build Type
Release
ICD debug
Debugger
Software Simulator
mikroICD Debugger
Comm_exp.c
volatile unsigned char data[12];
volatile char i,time_up,recieved,count;
unsigned char digit[3];
unsigned char prefix;
unsigned int adc_val;
void mcu_init()
{
//Lcd
Lcd_Config(&PORTB, 4, 5, 6, 3, 2, 1, 0); // Lcd_Init
Lcd_Cmd(Lcd_CLEAR);//Clear display
Lcd_Cmd(Lcd_CURSOR_OFF);//Turn cursor off
//for keypad
TRISD=0xF0;
//timer 1
INTCON.GIE=1;//global interrupt enable
INTCON.PEIE=1;//pheripheral interupt enable
PIE1.TMR1IE=1;//timer1 interrupt enable,
//USART
TXSTA=(1<<BRGH);
RCSTA=(1<<SPEN)|(1<<CREN);//enable serial port,contineous recieve enable
PIE1|=(1<<RCIE);//USART recieve interrupt enable
T1CON.TMR1ON=1;//enable timer 1
TRISC.F0=0;
}
unsigned char check_key()
{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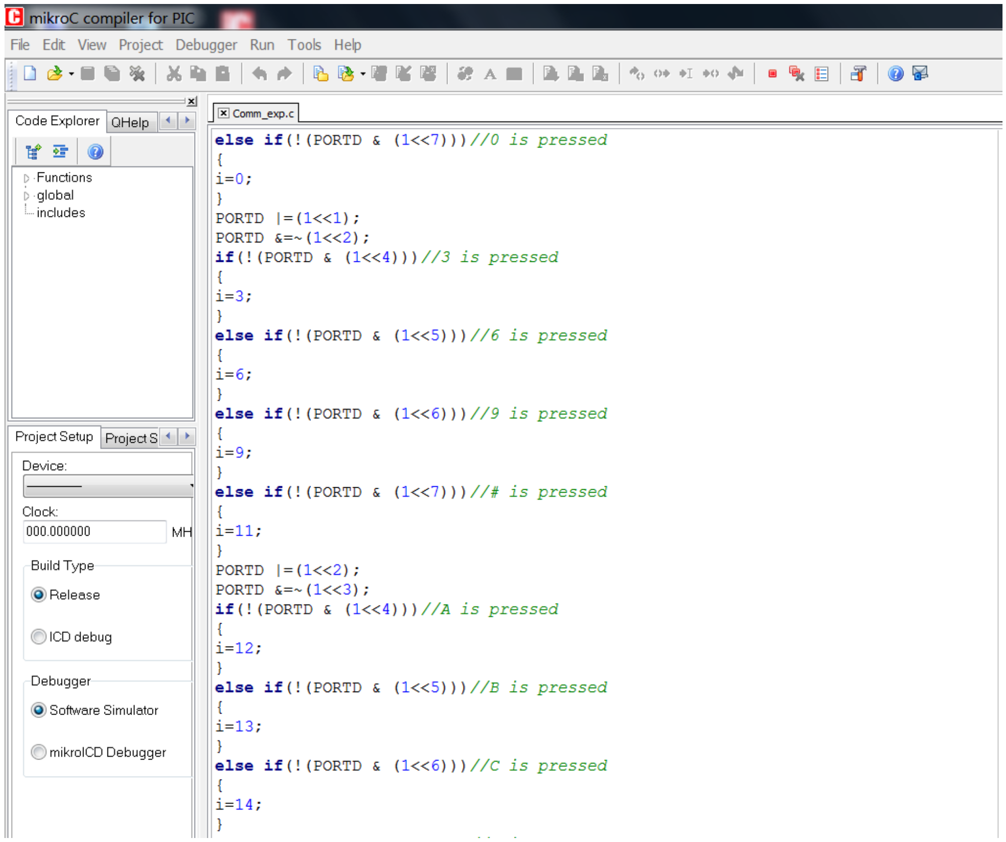
Code Explorer QHelp
Functions
global
includes
Project Setup Project S
Device:
Clock:
000.000000 MH
Build Type
Release
ICD debug
Debugger
Software Simulator
mikroICD Debugger
Comm_exp.c
{
unsigned char i = 255;
PORTD &=~(1<<0);
if(!(PORTD & (1<<4)))//1 is pressed
{
i=1;
}
else if(!(PORTD & (1<<5)))//4 is pressed
{
i=4;
}
else if(!(PORTD & (1<<6)))//7 is pressed
{
i=7;
}
else if(!(PORTD & (1<<7)))//* is pressed
{
i=10;
}
PORTD |=(1<<0);
PORTD &=~(1<<1);
if(!(PORTD & (1<<4)))//2 is pressed
{
i=2;
}
else if(!(PORTD & (1<<5)))//5 is pressed
{
i=5;
}
else if(!(PORTD & (1<<6)))//8 is pressed
{
i=8;
}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Project S
Device:
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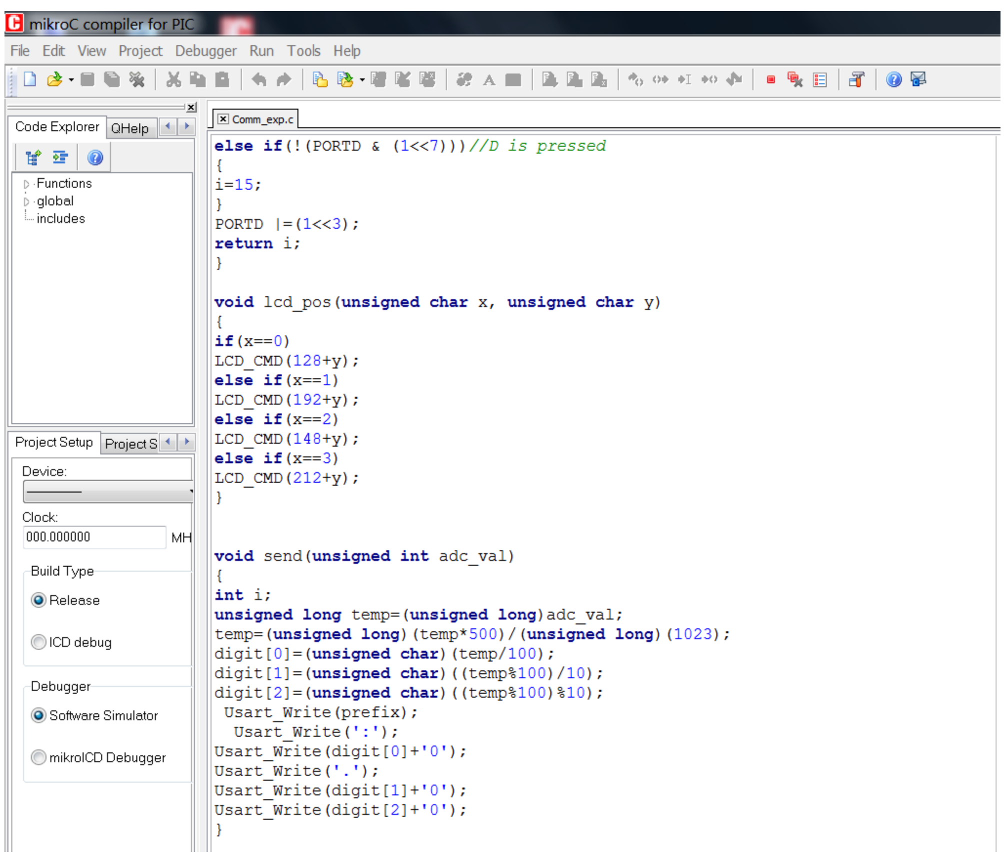
MH
Build Type
Release
ICD debug
Debugger
Software Simulator
mikroICD Debugger
Comm_exp.c
else if(!(PORTD & (1<<7)))//0 is pressed
{
i=0;
}
PORTD |=(1<<1);
PORTD &=~(1<<2);
if(!(PORTD & (1<<4)))//3 is pressed
{
i=3;
}
else if(!(PORTD & (1<<5)))//6 is pressed
{
i=6;
}
else if(!(PORTD & (1<<6)))//9 is pressed
{
i=9;
}
else if(!(PORTD & (1<<7)))//# is pressed
{
i=11;
}
PORTD |=(1<<2);
PORTD &=~(1<<3);
if(!(PORTD & (1<<4)))//A is pressed
{
i=12;
}
else if(!(PORTD & (1<<5)))//B is pressed
{
i=13;
}
else if(!(PORTD & (1<<6)))//C is pressed
{
i=14;
}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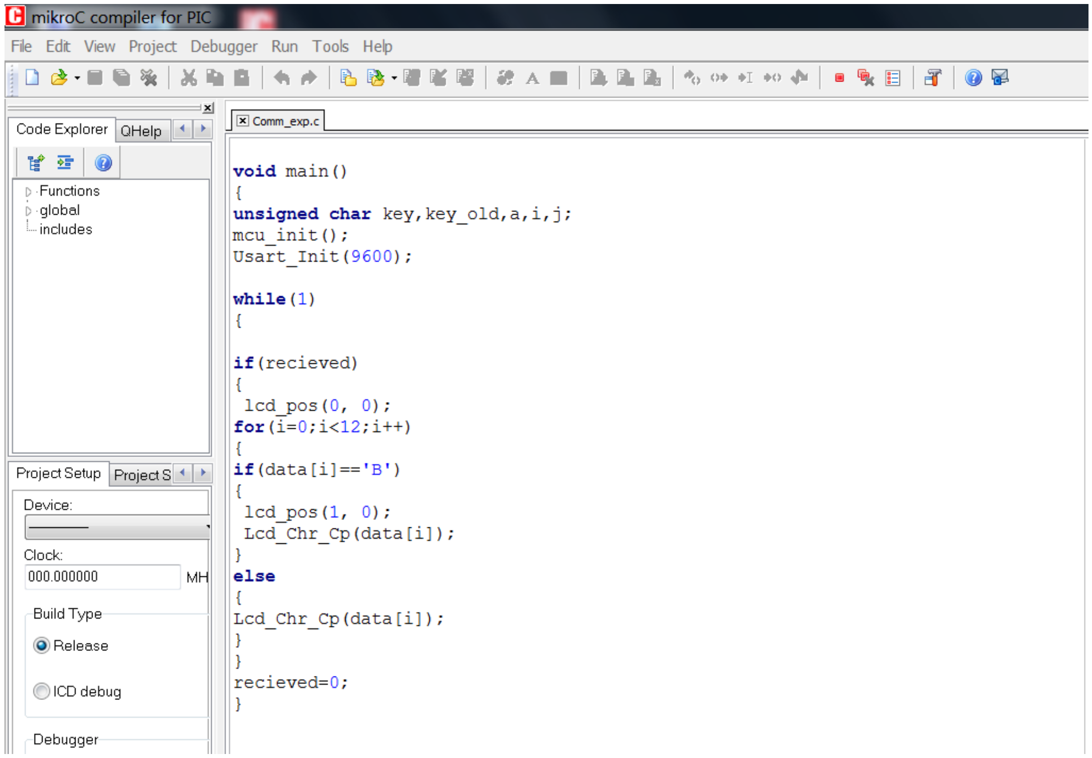
global
includes
Project Setup
Project S
Device:
Clock:
000.000000
MH
Build Type
Release
ICD debug
Debugger
Software Simulator
mikroICD Debugger
Comm_exp.c
else if(!(PORTD & (1<<7)))//D is pressed
{
i=15;
}
PORTD |=(1<<3);
return i;
}
void lcd_pos(unsigned char x, unsigned char y)
{
if(x==0)
LCD_CMD(128+y);
else if(x==1)
LCD_CMD(192+y);
else if(x==2)
LCD_CMD(148+y);
else if(x==3)
LCD_CMD(212+y);
}
void send(unsigned int adc_val)
{
int i;
unsigned long temp=(unsigned long)adc_val;
temp=(unsigned long)(temp*500)/(unsigned long)(1023);
digit[0]=(unsigned char)(temp/100);
digit[1]=(unsigned char)((temp%100)/10);
digit[2]=(unsigned char)((temp%100)%10);
Usart_Write(prefix);
Usart_Write(':');
Usart_Write(digit[0]+'0');
Usart_Write('.');
Usart_Write(digit[1]+'0');
Usart_Write(digit[2]+'0');
}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global
includes
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Project S
Device:
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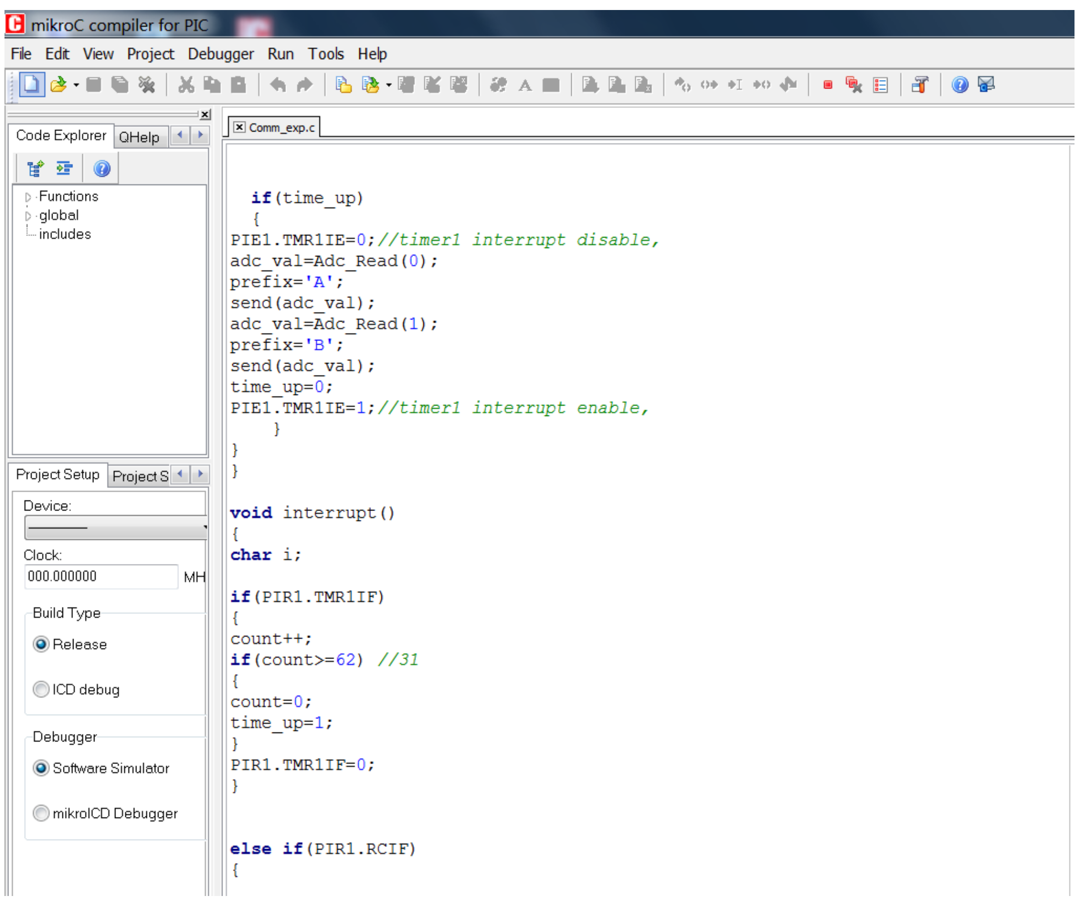
000.000000
MH
Build Type
Release
ICD debug
Debugger
Comm_exp.c
void main()
{
unsigned char key,key_old,a,i,j;
mcu_init();
Usart_Init(9600);
while(1)
{
if(recieved)
{
lcd_pos(0, 0);
for(i=0;i<12;i++)
{
if(data[i]=='B')
{
lcd_pos(1, 0);
Lcd_Chr_Cp(data[i]);
}
else
{
Lcd_Chr_Cp(data[i]);
}
}
recieved=0;
}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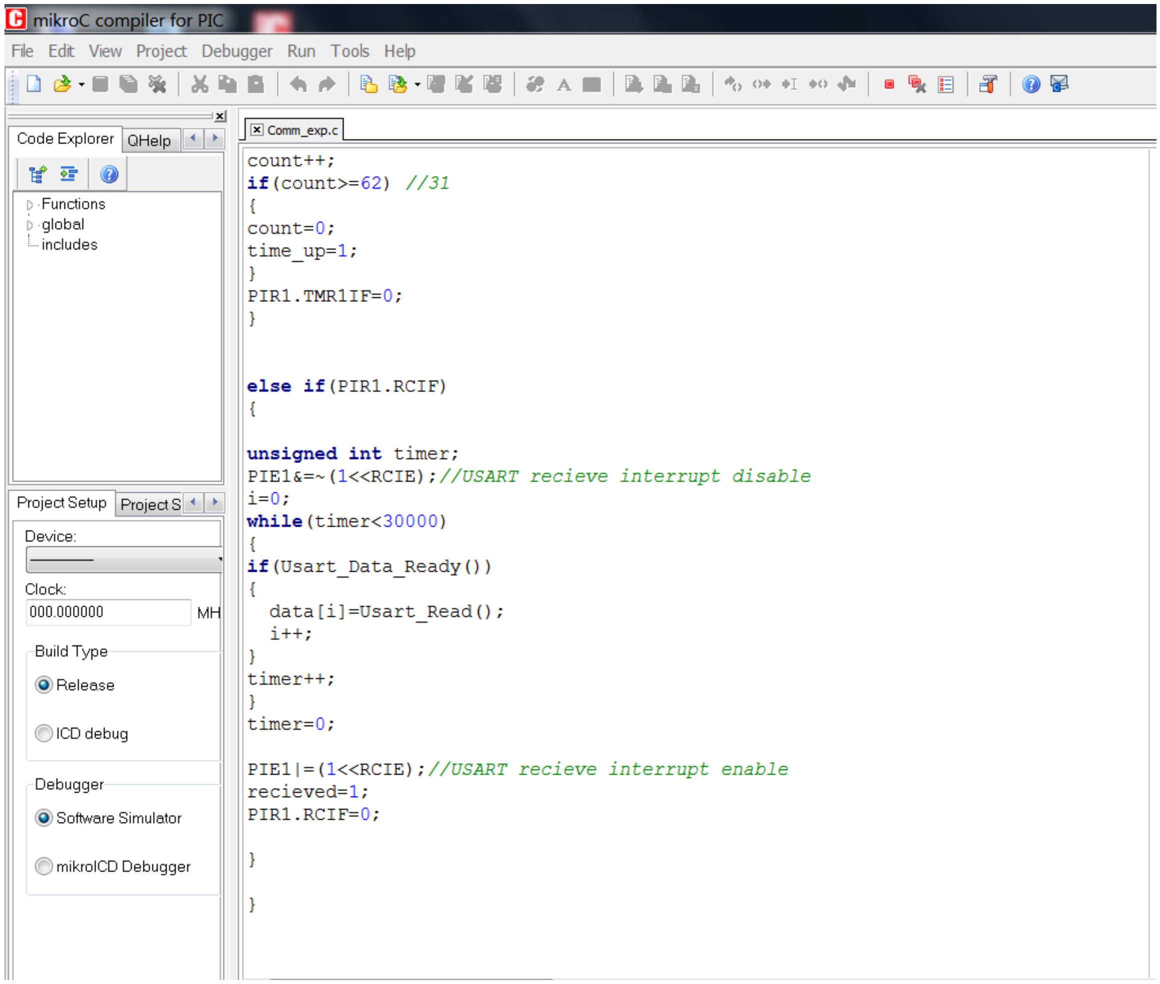
Debugger
Software Simulator
mikroICD Debugger
Comm_exp.c
if(time_up)
{
PIE1.TMR1IE=0;//timer1 interrupt disable,
adc_val=Adc_Read(0);
prefix='A';
send(adc_val);
adc_val=Adc_Read(1);
prefix='B';
send(adc_val);
time_up=0;
PIE1.TMR1IE=1;//timer1 interrupt enable,
}
}
}
void interrupt()
{
char i;
if(PIR1.TMR1IF)
{
count++;
if(count>=62) //31
{
count=0;
time_up=1;
}
PIR1.TMR1IF=0;
}
else if(PIR1.RCIF)
{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Release
ICD debug
Debugger
Software Simulator
mikroICD Debugger
Comm_exp.c
count++;
if(count>=62) //31
{
count=0;
time_up=1;
}
PIR1.TMR1IF=0;
}
else if(PIR1.RCIF)
{
unsigned int timer;
PIE1&=~(1<<RCIE);//USART recieve interrupt disable
i=0;
while(timer<30000)
{
if(Usart_Data_Ready())
{
data[i]=Usart_Read();
i++;
}
timer++;
}
timer=0;
PIE1|=(1<<RCIE);//USART recieve interrupt enable
recieved=1;
PIR1.RCIF=0;
}
}