CHILDREN MONITORING SYSTEM USING RADIO FREQUENCY (RF) TECHNOLOGY

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DEDICATION

Thankful To Allah the Almighty

To My Beloved Father and Mother:

ISHAK BIN DIN & MAZNIAH BT MD DERIS

… Your love and Sacrifice Will Be Always In My Mind…

My Beloved Siblings:

… May Allah Bless You All…

To My Supervisor:

DR. MOHAMED ARIFF BIN AMEEDEEN

…Thank A Lot for Support, Encouragement and Guidance…

To All My Friends:

All 3BCN,3BCG and 3BCS

… Thank for yours support and cooperation…

Sincerely

NURUL IZZAH BT ISHAK

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My fellow postgraduate students should also be recognized for their support. My sincere appreciation also extends to all my colleagues especially all 3BCN students and others who have provided assistance at various occasions. Their views and tips are useful indeed. Unfortunately, it is not possible to list all of them in this limited space. I am grateful to all my family members.

ABSTRAK

Sistem Pemantauan kanak-kanak (CMS) adalah peranti prototaip yang dibangunkan untuk mewakili idea asal yang dicadangkan iaitu sepasang alat yang direka untuk kanak-kanak dan ibu bapa di mana ia boleh mengurangkan kebimbangan ibu bapa akan kehilangan anak-anak mereka sementara membeli-belah dipusat membeli-belah. Ia juga memastikan keselamatan untuk mencegah kehilangan kanak-kanak itu apabila di tempat-tempat awam. Ini adalah kerana produk ini adalah berdasarkan kepada keadaan di mana kehilangan kanak-kanak berlaku apabila sedang membeli-belah atau di kawasan tumpuan ramai. Teknologi yang digunakan untuk prototaip ini adalah Radio Frekuensi (RF). Menurut Alina et al. (2010), radio frekuensi merujuk kepada arus ulang alik (AC) yang memegang unsur itu bahawa, jika arus input antena, elektromagnet (EM) dihasilkan sesuai untuk penyiaran dan komunikasi tanpa wayar. Keistimewaan produk untuk projek prototaip ini adalah peranti yang mewakili kanak-kanak boleh mengeluarkan kehilangan isyarat apabila ia mencapai had jarak yang telah ditetapkan iaitu 1.5m. Manakala peranti yang mewakili sebagai ibu atau bapa juga boleh mengeluarkan isyarat bunyi dan memaparkan bahawa "anak-anak yang hilang" di LCD apabila ia mencapai had jarak yang telah ditetapkan. Ini membolehkan, ibu bapa menyedari di mana anak-anak mereka dan terus mendapatkan anak-anak mereka serta dapat mengelakkan daripada kehilangan berlaku.

ABSTRACT

Children Monitoring System (CMS) is a prototype device which is developed to represent how the original idea proposed which is a pair of device that are designed for children and parents where it can reduce the anxiety of the parents will lose their children while shopping at the mall. It also ensures security to prevent the disappearance of the child when in public places. This is because this product is based on the situation in which the loss occurred when the children are shopping or while in a lot of people. Technology used for this prototype is Radio Frequency (RF). According to Alina et al. (2010), radio frequency refers to alternating current (AC) which hold element such that, if the current is input to an antenna, an electromagnetic (EM) field is produce appropriate for wireless broadcasting and communications. Privileges available to product are the device that represent as children may issue loss of signal when it is reach the limitation distance which is 1.5m for this prototype project. While the device that represent as the mother or father also may emit a sound signal beep and display that "kids are missing" at the LCD when it is reach the limitation distance. Currently, parents will know where their children and continue to get their children and aware from any missing occur.

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CMS	**=**	**CHILDREN MONITORING SYSTEM**
RF	**=**	**RADIO FREQUENCY**

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

The objectives of this study are to produce a prototype device to facilitate the parents/users to keep their children while they were in a shopping mall and public areas. This chapter includes the background, research objectives, problem statement and also relevant information according to research study which is collected from different journals and articles.

As cited in TheStar (2007), children regularly get separated from their parents at shopping malls. Indicate that at least five cases of lost children were reported every month in the shopping mall. Case of lost children in a shopping mall can be said to occur almost every day, not just on weekends all around our country.

Among the identified causes of the cases are often attracted to children and stop at certain parts of the shopping centers such as compact discs store video (VCD) or the center of the game so it was not noticed by their parents. And often, it is the case of adults allowing their children to wander off on their own. This is because the shopping center will be packed with the presence of visitors, leaving the default of parents to control children who are brought.

The child will cry to find their parents missing, and usually will be easily met anyone who approached. If you see security guards in shopping centers they would bring the child to the customer service counter to be informed. But if they meeting with stakeholders or criminals, the fate of these children do not know yet. What things should be done by parents to ensure their children's safety guaranteed?

Child Monitoring System (CMS) is a product which is intended to develop where it can reduce the anxiety of the parents will lose their children while shopping at the mall. It also ensures security to prevent the disappearance of the child when in public places. This is because this product is based on the situation in which the loss occurred when the children are shopping or while in a lot of people.

"CMS” is a pair of device that is designed for children and parents. Technology used for this device is Radio Frequency (RF). According to Alina et al. (2010), radio frequency referring to alternating current (AC) hold elements which is, if the current is input to an antenna, an electromagnetic (EM) field is produced suitable for all wireless broadcasting and communication.

Privileges available to product are the device that represent as children may issue loss of signal when it is reach the limitation distance which is 1.5m for this prototype project. While the device that represent as the mother or father also may emit a sound signal beep and display that “kids are missing” at the LCD when it is reach the limitation distance. Currently, parents will know where their children and continue to get their children and aware from any missing occur.

RF is a term which is always referring to an electrical oscillation, as opposed to a mechanical oscillation. However, it is important to note that mechanical systems of this type do indeed exist (as cited in Smith et al. 2005). There is lots of types of wireless devices that used of RF areas. With this, parents will know the location of their children. Sound on the bracelet worn by the children will sound aloud when their parents approach their children. This product may have a high potential market for many parents with small children want to ensure the safety of their children.

With the emergence of “CMS”, hopes that cases of lost children can be reduced. Even it can help parents with small children to supervise their children during the busy shopping at malls or in the focus areas of the public. This tool can also warn parents about the conditions of their children if parents are busy in the shopping mall for example, when their children play away from their parents.

1.2 PROBLEM STATEMENT

The problem statements of this project are:-

- Parents difficult to monitor their children when they are busy shopping or at public area.
- The disappearance of the child at the public’s attention often occurs.
- Difficulties in finding the children who escaped from the supervision.

1.3 OBJECTIVES

The objective of this project is:-

- To develop a prototype project that can help to assist user in detect a missing children.
- To create a pair of device used RF technology that can detect each of devices which is will emit a sound and LED signal when it reach the distance limit.
- To help user to prevent from any missing and aware from any missing occur in limitation distance.

1.4 SCOPE

The scope of this project include:-

Technology

- RF referring to radio frequency, which is any frequency within the electromagnetic spectrum associated with radio wave propagation. When an RF current is supplied to an antenna, an electromagnetic area is created that then is able to broadcast through space. Many wireless technologies are based on RF area propagation.

User

- This project is actually developed for parents that want to secure their children in a crowded area such as shopping complex. But for this prototype project design, the user is students and lecturer who will evaluate and make the project testing.

1.5 THESIS ORGANIZATION

This thesis consists of four (4) chapters. Chapter 1: Introduction briefly describes and introduces the system. This system preliminary shows the basic concept of the system, problem statements of the system, objectives, scopes, and how the report is organized. Chapter 2: Literature Review depicts the manual systems and the existing systems as the case studies of the project. This chapter also reviews the technique, method, equipment, and technology that had been used in the case studies. Chapter 3: Methodology discusses about the overall workflow in the development of the project. This chapter also discusses the method, technique or approach that has been used while designing and implementing the project. Chapter 4: Conclusion briefly summarizes the project.

CHAPTER II

LITERATURE REVIEW

This chapter briefly describes the review on existing techniques related with the proposed project. This chapter comprises three sections. The first section describes some brief information on Radio Frequency (RF), RF spectrum and RF applications. The second describes Applications of RF in Detection, while the last section describes the review on method, equipment, and technology previously used in the same domain.

2.1 RF

RF term refer to Radio Frequency. Radio Frequency usually referring to a rate of oscillation that takes place between range of 30 kHz to 300 Ghz. These correspond is used to transmit and receive radio waves to a special frequency that, which is where the name comes from (Patil et al. 2005). Many wireless technologies are referring to RF field propagation.

According to Rouse, 2006, wireless usually refers to describe telecommunications where electromagnetic waves transmit the signal over part or the entire communication path. Some monitoring devices, such as intrusion alarms, employ acoustic waves at frequencies above the range of human hearing. These are also sometimes categorized as wireless.

On early 20th century, the first wireless transmitters went on the air in the by using radiotelegraphy or usually known as Morse code. The medium came to be called "radio" after that as inflection made it possible to transmit voices and music via wireless. The term "wireless" has been resurrected by way of the arrival of television, fax, data communication, and the efficient use of a larger segment of the spectrum (as cited in Rouse, 2006).

Wireless technology is hastily evolving, and is playing a growing part in the lives of people all the way through the world. Besides, ever-larger numbers of people are relying on the technology directly or indirectly. Examples of wireless communications and control consist of:

- Global System for Mobile Communication (GSM) which is a digital mobile telephone system used in Europe and other parts of the world.
- General Packet Radio Service (GPRS) which is a packet-based wireless communication service that provides continuous connection to the Internet for mobile phone and computer users.
- Enhanced Data GSM Environment (EDGE) which is a faster version of the Global System for Mobile (GSM) wireless service.
- Universal Mobile Telecommunications System (UMTS) which is a broadband, packet-based system offering a consistent set of services to mobile computer and phone users no matter where they are located in the world.

- Wireless Application Protocol (WAP) which is a set of communication protocols to standardize the way that wireless devices, such as cellular telephones and radio transceivers, can be used for Internet access.
- i-Mode which is the world's first "smart phone" for Web browsing, first introduced in Japan that provides color and video over telephone sets.

Wireless term can be divided to:

I. Fixed wireless - the operation of wireless devices or systems in homes and offices, and in particular, equipment connected to the Internet via specialized modems
II. Mobile wireless - the use of wireless devices or systems aboard motorized, moving vehicles. Examples include the automotive cell phone and Personal Communications Services (PCS).
III. Portable wireless - the operation of autonomous, battery-powered wireless devices or systems outside the office, home, or vehicle; examples include handheld cell phones and PCS units.
IV. IR wireless - the use of devices that convey data via IR (infrared) radiation which is employed in certain limited-range communications and control systems.

There are lots of services that operates in RF spectrum such as cordless and cellular telephone, radio and television broadcast stations, satellite communications systems, and two-way radio services. Some wireless devices operate at IR usually known as visible-light frequencies, which is electromagnetic wave lengths are shorter than those of RF fields. Television-set remote-control boxes, some cordless computer keyboards and mice, and a few wireless hi-fi stereo headsets are most known example for this technology (as cited in Rouse, 2008).

It gives rise to an electromagnetic field that propagates through space once an RF current is supplied to an antenna. This field is sometimes called an RF field, in less technical terminology it is a "radio wave." Any RF field has a wave length that is inversely proportional to the frequency. In the atmosphere or in outer space, if*s* is the wavelength in meters and *f* is the frequency in megahertz, so :

$$s = 300/f$$

The frequency of an RF signal is inversely comparative to the wavelength of the EM field to which it corresponds. At 9 kHz, the free-space wavelength is around 33 kilometers (km) or 21 miles (mi). At the highest radio frequencies, the EM wavelengths measure approximately one millimeter (1 mm). As the frequency is increased beyond that of the RF spectrum, EM energy takes the form of infrared (IR), visible, ultraviolet (UV), X rays, and gamma rays.

For an oscillating or varying current, frequency is the number of complete cycles per second in alternating current direction. The standard unit of frequency is the hertz, abbreviated Hz. The standard alternating-current utility frequency in some country if a current completes one cycle per second, then the frequency is 1 Hz, 60 cycles per second equals 60 Hz.

Larger units of frequency include the kilohertz (kHz) represents thousands (1,000's) of cycles per second, the megahertz (MHz) represents millions (1,000,000's) of cycles per second, and the gigahertz (GHz) represents billions (1,000,000,000's) of cycles per second. Occasionally the terahertz (THz) is used; 1 THz = 1,000,000,000,000 cycles per second. Note that these prefixes represent specific powers of 10, in contrast to the prefix for multiples of bytes, which represent specific powers of 2.

Distance between identical points in the adjacent cycles of a wave form signal propagated in space or along a wire, is known as wavelength. In wireless systems, this length is usually specified in meters, centimeters, or millimeters. In the case of infrared, visible light, ultraviolet, and gamma radiation, the wavelength is more often specified in nanometers (units of 10^{-9}meter) or Angstrom units (units of 10^{-10} meter).

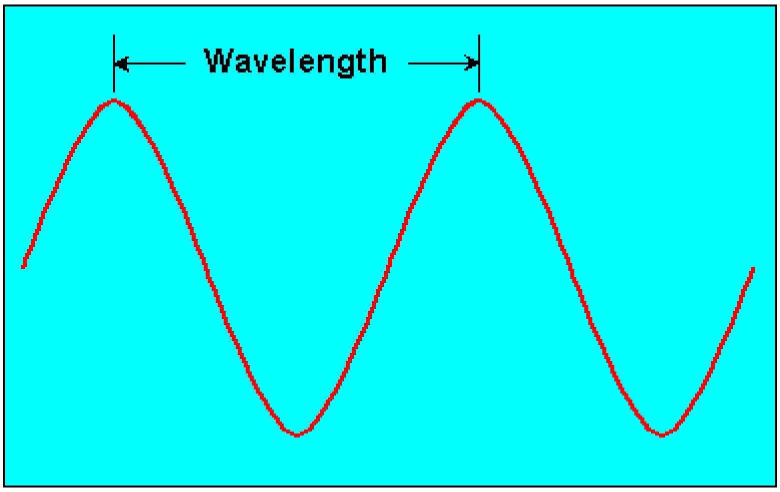


Figure 2.1.1 – Wavelength

Wavelength is related to frequency. The higher the wavelength of the signal, then the shorter the frequency. If f is the frequency of the signal as measured in megahertz, and w is the wavelength as measured in meters, then

$$w = 300/f$$

and conversely

$$f = 300/w$$

The RF spectrum is divided into several ranges, or bands. With the exception of the lowest-frequency segment, each band representing the increase of frequency corresponding to an order of magnitude (power of 10). The table depicts the eight bands in the RF spectrum, showing frequency and bandwidth ranges. The SHF and EHF bands are often referred to as the microwave spectrum (as cited from Rouse, 2008).

Table 2.1.1 : RF frequencies and properties (as cited from Rouse, 2008)

Designation	Abbreviation	Frequencies	Free-space Wavelengths

1. Very Low Frequency	VLF	9 kHz - 30 kHz	33 km - 10 km
2. Low Frequency	LF	30 kHz - 300 kHz	10 km - 1 km
3. Medium Frequency	MF	300 kHz - 3 MHz	1 km - 100 m
4. High Frequency	HF	3 MHz - 30 MHz	100 m - 10 m
5. Very High Frequency	VHF	30 MHz - 300 MHz	10 m - 1 m
6. Ultra High Frequency	UHF	300 MHz - 3 GHz	1 m - 100 mm
7. Super High Frequency	SHF	3 GHz - 30 GHz	100 mm - 10 mm
8. Extremely High Frequency	EHF	30 GHz - 300 GHz	10 mm - 1 mm

Before radio communication can be received, it is necessary to have an antenna in place to pick it. Yet, it will pick up at the exact same time during use, a tuner is needed to narrow down the source of the signal, since an antenna cannot distinguish between lots of signals (as cited from Walker, 2010).

To help you to tune into a specific frequency, a tuner can be used which will in turn help you control what "channel" you are dialing into and picking up with your antenna. The tuner always makes use of a resonator that amplifies oscillations of the preferred frequency to a point where they are distinguishable over the rest of the "noise" (as cited from Walker, 2010).

In the medical field, RF energy is also used. Example of RF used for medical field such as some minimally invasive surgeries that make use of RF energy for coagulation and radio frequency ablation. This technology can be used to treat conditions such as sleep apnea (as cited from Walker, 2010).

RF electrical currents also display a very interesting set of properties. For example, RF currents can ionize air and create conductive paths right through it. Another example is how RF electrical currents travel along the surface of conductors instead of penetrating through or the "skin effect" (as cited from Walker, 2010).

2.2 Applications of RFID in Detection

2.2.1 Asset Tracking via Robotic Location Crawling

Reference: Patil, Munson, Wood & Cole. (2005). "BlueBot: Asset Tracking via Robotic Location Crawling*". IBM Research Report.*

Asset Tracking via Robotic Location Crawling represents a prototype automatic location sensing-system that combines RFID technology and off-the-shelf Wi-fi based continuous positioning technology for asset tracking in indoor environments. The system employs a robot, with an attached RFID reader, which periodically crawls the space, associating items it detects with its own location determined with previous samples to compute its location. Asset tracking knowing what user have and where it is located. It is essential for the smooth operation of large manufacturing companies. It also assists big retailers isolate bottlenecks in their supply chain, reduce overstocking or locate spoiled cargo.

Automatic location sensing is the key to enabling such tracking applications. One of the most well-known positioning system is GPS, which relies on satellites to track location. However, due to its dependence on satellites, GPS lacks the ability to exactly determine location inside buildings. Steggles and Cadman (2010) provide a good comparison of various RF-tag-based location sensing technologies. Many of the current location sensing system are radio based (Wi-fi, Bluetooth). By using base station visibility and signal strength or time of flight, it is possible to locate Wi-fi devices with an accuracy of several meters. Normally, these systems use an ultrasound time-of-flight measurement technique to provide location information. Most of them share a significant advantage, which is the overall accuracy.

The asset tracking technologies mentioned above are mostly geared towards tracking items that individually have high value. These items require continues tracking and justify the use of the expensive tracking equipment. However, in many tracking applications (e.g. the library scenario described earlier) the object being tracked is either too small or too low value to justify the use of a tracking system with high per-item cost. There are many applications where it is valuable to know the precise location of an asset, yet it is permissible for an asset's location to be updated on a periodic basis.

Table 2.2.1 – Tracking System Taxonomy

		Continuous in Space	
		YES	NO
Continuous in Time	YES	GPS, TDOA, EOTD, Wi-Fi signal strength, etc.	Simple "presence" technologies (e.g., cellular system where cellID is reported as the cellphone's location)
	NO	**BlueBot**	Fixed Beacon (e.g., EZPass, Bluetooth)

2.2.2. RFID-Based Techniques For Human-Activity Detection

Reference : Smith, Fishkin, Jiang, Mamishev, Philipose, Rea, Roy & Rajan (2005).RFID-Based Techniques For Human-Activity Detection. *COMMUNICATIONS OF THE ACM*, (Vol. 48, No. 9).

In spite of this daunting RFID limitation for tracking human activity, there are two very different approaches, both based on RFID have been pursue for this research. The iBracelet is a wrist-worn short-range RFID reader that detects object use via hand proximity. The Wireless Identification and Sensing Platform (WISP) is a family of long-range RFID tags amplified with sensors that detect object motion, they eliminate the need to wear something by moving from short-range tags matched with wearable readers to long-range motion sensitive tags read by fixed infrastructure.

While both approaches modify and extend conventional RFID, neither requires batteries in the objects being tracked. WISPs deliver the motion detection capabilities of active sensor beacons in the same battery-free form factor as RFID tags using line powered readers.

The iBracelet system uses just one battery to power its wrist-worn reader and yields information about who is using particular objects not directly available through the WISP approach. The wearable reader also gives the subjects being monitored more control over the system, since users can more conveniently disable it-by taking it off-than user have with the fixed-reader infrastructure, iGlove**.** Glove have been created in 2003 as part of first effort to track object use with RFID. While the early prototype was too crude for true long-term deployment, it was usable and durable enough that were able to enlist 14 volunteers to wear it while conducting a range of daily household tasks, averaging approximately 45 minutes per user. By tracking the objects they grasped, it was generally able to figure out which and when activities they performed.

Figure 2.2.1 - The iBracelet

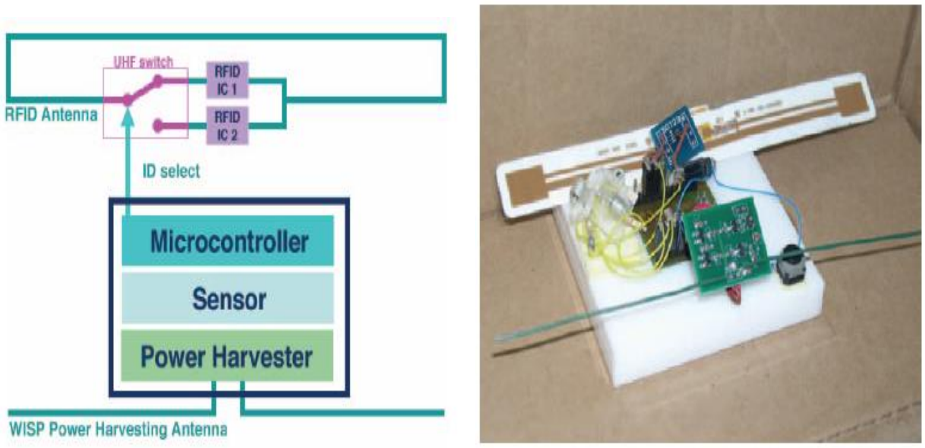


Figure 2.2.2 - Block diagram of the WISP (left) and photograph of a functioning Implementation (right).

The WISP implementation uses separate antenna for power and for communication. The power-harvesting antenna is at the bottom of the diagram; in the photo, it is the pair of straight green wires emerging from the power-harvesting circuit board toward the bottom of the image. The microcontroller and sensor are above the harvester in the diagram. In the photo, the microcontroller is mounted on the reverse side of the circuit board in the center of the plastic mounting block. The assembly to the left of the microcontroller is the three-axis mercury acceleration sensor. At the top are the RFID chips and antenna used in the ID modulation process. The UHF RFID-select switch is mounted on the small circuit board in front of the RFID antenna.

RFID-based sensing of object use provides computers a view of human activity that is unprecedented in detail and breadth. This family of techniques can help solve the longstanding problem of how to infer human activity. While the iBracelet and the WISP both use RFID for human-activity inference, each represents a quite different solution, appropriate in different circumstances.

The WISP approach appears promising for a variety of sensing problems, in addition to human-activity referencing, in which battery free operation or compatibility with RFID infrastructure is key. The iBracelet appears most promising for industrial or enterprise-context human activity inference applications in which a wearable reader is not a oppressive requirement. The WISP approach appears to be suited to more casual or consumer scenarios in which a wearable device is not acceptable. As researchers gain more experience in human-activity inference, it will be interesting to discover which combination of approaches turns out to be most suitable for real-world applications and environments.

2.2.3. RFID Product Authentication in EPCglobal Network

Reference: Cristina TURCU (2009), Development and Implementation of RFID Technology.

RFID Monitoring System (RFIDMS) is suggested to provide an EPCglobal-like architecture framework, which provides the platform of frontend software/hardware including tag, reader, and middleware with AP-based gateway and signed applets for other interface systems. At the backend, the software shall include ALE, EPCIS database, and EPCIS query interface. The J2EE applications can include receiving the raw data from the feedback of Middleware Servlets, the query of web services, and the alarm message of monitoring system. The EPCglobal-like architecture framework is mainly divided into two parts. The top one is the RamMIS itself. The second is the RFID monitoring system (RFIDMS). The signed-applets are designed for receiving/applying at stock house, and for other information interface systems. It contains the parts of EPCIS access interface, access/application interface (ALE) software, filtering/collecting interface, filtering & collecting (RFID middleware), and reader protocols. The blue color representative represents the interface for EPCglobal standard and brown color represents the hardware/software. Thus, there are a lot of design work can be done with different requirements for material handling.

The tag, reader, and middleware are the front-end hardware/software. They need Apbased gateway PC and signed applets are used to provide the other interface systems to show their instant information. The ALE, EPCIS database, and EPCIS inquiry interface are the back-end software. J2EE applications mainly provide the following functions:

- To receive and process the Servlets of raw data from middleware software.
- To provide the inquiry response of web services from general purpose equipment.
- To provide the maintenance report for alarm message, etc.

The EPCglobal-like architecture framework is shown in Figure 2.2.1. This framework provides the needs of design items for each different faces on the website.

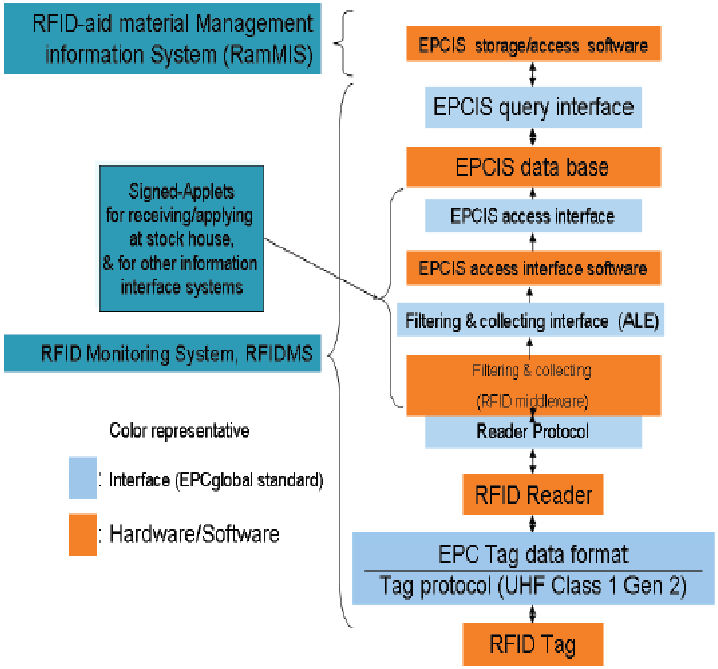


Figure 2.2.3 - EPCglobal-like architecture framework

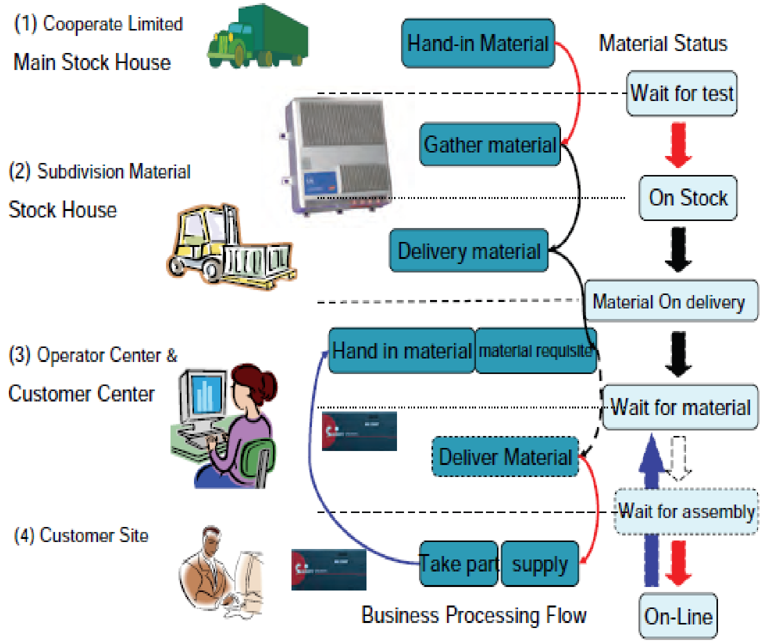


Figure 2.2.4 - RFID materials monitoring flow

The material monitoring flow of RFID Monitoring System (RFIDMS) is shown in Figure 2.4.

However, only few researches concerning on application of RFID in safety detection.

2.2.4 Smart Parking Applications Using RFID Technology

References: Zeydin PALA and Nihat INAN. Jin Wen Univ of Science and Technology

In this study, a solution has been provided for the problems encountered in parking-lot management systems via RFID technology. RFID readers, RFID labels, computers, barriers and software are used as for the main components of the RFID technology. The software has been handled for the management, controlling, transaction reporting and operation tasks for parking lots located on various parts of the city. Check-ins and check-outs of the parking-lots will be under control with RFID readers, labels and barriers. Personnel costs will be reduced considerably using this technology. It will be possible to see unmanned, secure, automized parking-lots functioning with RFID technology in the future.

Check-ins and check-outs will be handled in a fast manner without having to stop the cars so that traffic jam problem will be avoided during these processes. Drivers will not have to stop at the circulation points and parking tickets will be out of usage during check-ins and check-outs. It will be avoided ticket jamming problems for the ticket processing machines as well. Vehicle owners will not have to make any payments at each check-out thus a faster traffic flow will be possible.

Since there won't be any waiting during check-ins and check-outs the formation of emission gas as a result of such waiting will be avoided. An atomized income tracking system, a car tracking system for charging and a central parking-car tracking system have been developed and utilized. Instead of cars' parking on streets, a more modern and a fast operating parking-lot system have been developed.

It is the sole purpose of this study to utilize such an important technology with an application. In this study, via RFID technology, some solutions are provided for the problems encountered in parking lot management systems to the present and some important results have been gathered. In this study, the main components of RFID technology which are RFID readers, RFID labels, a barrier to control the gate
and software have been utilized. The software aimed to handle the management, controlling, transaction reporting and operation tasks for parking lots located on various parts of the city.

As for the hardware requirements, by the utilization of RFID readers, barriers and labels, parking-lot check-in and check-out controls have been achieved. In that way, as an alternative to personnel-controlled traditional parking-lot operations, an unmanned, atomized vehicle control and identification system has been developed.

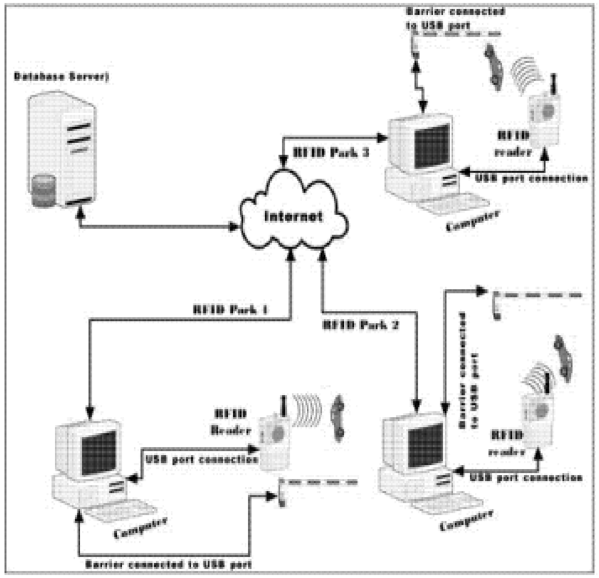


Figure 2.2.5 – Application Scheme

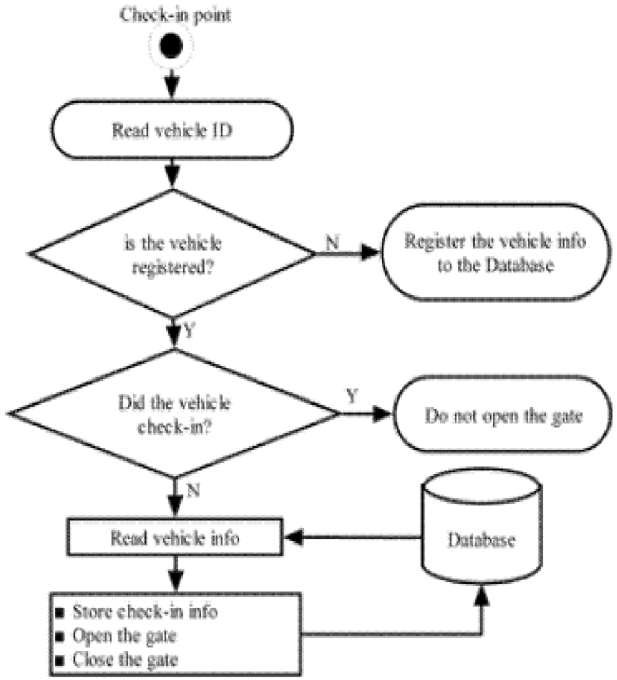


Figure 2.2.6 - Parking-lot Check-in Process

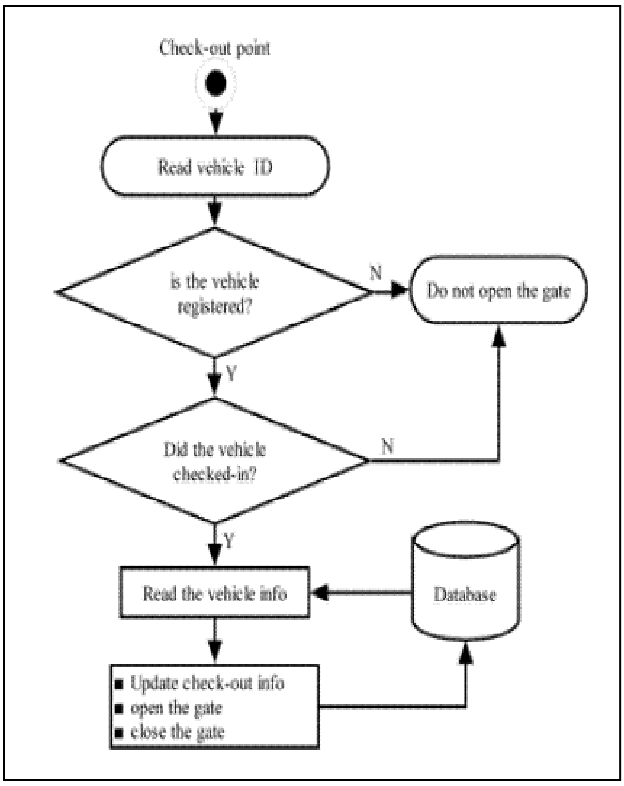


Figure 2.2.7 - Parking-lot Check-out Process

In this application, a vehicle's identification information is searched on the central database first, if a vehicle doesn't have any previous records registered to the database, the initial entry level information of a vehicle is stored in the database. If a vehicle has a previous record stored on the system, there won't be any secondary information entries thus duplicate entries will be avoided.

Under normal circumstances, if a vehicle checks-in to a parking-lot without RFID notification, that vehicle will not be able to check-out afterwards. In that way, unauthorized entries will be avoided. If a checked-in vehicle does not get checked-out, it won't be able to check-in to any of the parking lots in the city. Only the administrator of the central database could bring a solution to this problem.

Identification information of the registered vehicles within the coverage area of an RFID reader will constantly be read. If in this process, a vehicle's information is recorded into the database there will be duplicate entries and this will cause problems within the system. To avoid this problem, reading task is done when the vehicles gets out of the range of the RFID reader.

2.3. Technology

2.3.1 Equipment for RF

Active tags, which are a subclass of RFID tags, use batteries to power their communication circuitry, sensors, and microcontroller. Active tags benefit from relatively long wireless range (approximately 30 m) and can achieve high data and sensor activity rates. However, the batteries required by active tags are disadvantageous for device cost, lifetime, weight, and volume. In contrast, passive sensor tags receive all of their operating power from an RFID reader and are not limited by battery life. There are several examples of application-specific nonprogrammable passive tags with integrated temperature and light sensors, as well as an analog-to-digital converter (ADC). Active tags have their own battery source. They do not have to wait to be awakened by a reader, but are capable of initiating communication with a reader and continually broadcasting their stored information. They also have a much longer read range of several hundred feet, some of up to 750 feet, depending on battery power. The batteries in these tags normally last several years. Active tags typically have internal read and write capability, their own batteries, and can transmit their signals over a longer distance. Depending upon the size of the tag and the frequency used, the current range of reception, or read range, of the reader is limited.

Passive tags draw power from the reader and are cheaper and smaller than active tags, which have a battery used to broadcast the signal to the reader. Usually passive tags are preferred for tagging good as they are much cheaper, long lived, lightweight and have smaller foot print. However since passive tags work without a battery, they have a very small detection range. Current RFID system is portal based where tagged items are scanned either when they enter or leave a facility. Passive tags are so termed because they have no internal power source and perform no actions until they are awakened by receiving energy waves in the radio signal emitted by a reader. Studies from the United States Department of State have shown that tags envisioned to be read from a few inches can actually be awakened and read at distances of more than twenty feet, with others scientists demonstrating that they can be read at greater than sixty-nine feet. Since these tags have no internal battery, they can be small, easy to embed, quite cheap to produce, and can successfully operate for a long period of time.

Semi-passive tags use an internal battery to ensure data integrity, however the signal sent from the reader generates the power to transmit the signal from the tag. RFID is an extension of existing bar code technology and is fully integrated with the EPC global Network.

Some tags are called “smart” because they possess the technological capability to include some forms of security protection for transmission of sensitive data. These chips are sophisticated enough to allow the layering of data protection processes, such as cryptography and authentication, on top of the core radio frequency technology actions performed by the chip. However, these tags are only as “smart” as the decision-makers who decide what types of protections should be built onto these chips and how effective these protections actually are against privacy and security attacks.

A semi active RFID reader is a reader with its own power source, but it wakes up through external trigger-like sensors. A master reader is a reader which controls other slave readers or tags. A slave reader behaves like a tag, but it operates under the control of master reader when it is awoken. The master reader is a conventional powerful fixed reader with a direct fixed or wireless connection to the smart spaces back-end system. It carries out the reader services demanded by the smart spaces system. It initiates a read process in active slave reader and wakes up any passive or semi-active reader or tag for power up or any other service initiation. In addition, it collects the item-level information and forwards it to the backend for further processing. Any type of MRFID reader entering in its range can be connected directly or via slave readers. A MR communicates with other MRs in the smart spaces. It can also work as a proxy between MRFID reader and local or remote server systems for information service provisioning.

A number of Slave Passive Readers (SPR) SPRs are very simplified passive readers for capturing tag ID information in their radio range. The aggregated information is provisioned to the master reader or any mobile reader or any other intelligent tag visiting the SPR range. SPRs act as a relay capturing transmission power from any active reader like the master reader, and reflect the power to tags which have not woken up from the master reader's direct power. The reflected power of the reader is very limited and it is proportional to the received master reader's power. The reflected power reduces by square related to the distance of the tags. This type of reader would be useful where some tags are not reachable by the direct radio transmission of master or active slave readers. Nevertheless SPRs can be used at least for localization of the tags, when the physical location of the slave reader is known to the system. The master reader can find the location of the tags identified from the slave reader based on slave reader location.

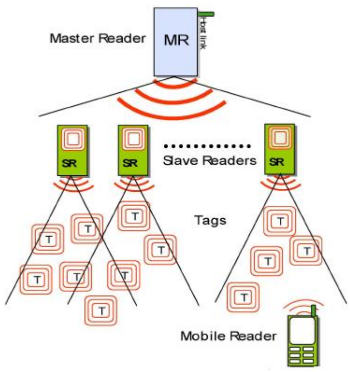


Figure 2.3.1 - Simulation for Master Reader and tag

Table 2.3.1- RFID frequencies – Properties and general applications

RFID type	**Frequency range**	**Read distance**	**Transmission rate**	**General application**
Low frequency (LF)	Less than 0.300 MHz	0.45 m or 1.5 ft	5-98 kbps	- Security access - Automobile - Library book ID - Clothing ID - Toll roads - Rail car ID - Toll collection - Anti-counterfeiting
High frequency (HF)	3-3- MHz	0.91 m or 3 ft	106 kbps	
Ultra-high frequency (UHF)	860-950 MHz	1.8-4.6 m or 6 to 15 ft	115.2	
Microwave frequency	2450-5800 MHz	2.5-30 cm or 1-12 inch	435.2 kbps	

RFID which was perceived can bring in many benefits such as better management of inventory, improved security, improved efficiency, increased visibility, and reduced cost, its implementation is not straightforward. A number of issues and challenges, such as security/ privacy concern, high cost, lack of standards, data integration, reliability of the technology, and employee resistance to change, yet need to be addressed. Reducing implementation cost and determining accurate measures for RFID return on investment (ROI) remain as critical and challenging tasks. Previous research on justifying RFID investment decisions predominately focused on cost-benefit analysis or using discounted cash flow (DCF) technique.

Common criticisms about these valuation methods are, first, potential for cost savings and benefits is difficult to judge and quantify in advance due to a high-level of uncertainty existed, second, DCF assumes that all investments are irreversible. However, managers often have the ability to influence the results of a project and have recourse to abandon a project if results are poor or expand projects if results are better than expected, third, managerial flexibilities have perceived to have value for investment but it was not valued by the traditional method.

Table 2.3.2- RFID frequencies – Advantages and disadvantages

RF type	**Advantages**	**Disadvantages**
Low frequency (LF)	Communicates best with items containing water or metal	- Large tag size - Higher tag costs - Limited capability to read multi simultaneously

		(anticollison)
High frequency (HF)	-Tags can be flat labels, some with 1cm diameter - Lower tag costs than LF -Established global manufacturing standards	- Difficult to read multiple HF tag simultaneously in Densely packet slides
Ultra-high frequency (UHF)	- Increasing diversity in tag sizes and tissue blocks -Established global manufacturing standard ISO 18000-6c - Good capability to read multiple UHF tags simultaneously - Lower tag costs	- Typically does not function well when surrounded by high water - Actual frequency varies
Microwave frequency	Small tag size	- Limited number of suppliers - Higher costs - More common for active tags

CHAPTER III

METHODOLOGY

In this chapter will discuss about the methodology that will be using in the development of this project. For develop “CMS”, the Rapid Application Development (RAD) method was chosen because RAD have several characteristic that is suitable for the development of this project. There have three section consists in this chapter. The first section explains about the introduction of the RAD development method and the reason to choosing the RAD approach. The next section discuss about the implementation of RAD method in this project development. The last section will elaborate the hardware and software that was used in the development of this project.

3.1 Rapid Application Development (RAD)

Rapid application development (RAD) is a software development methodology that uses minimal planning in favors of rapid prototyping. The planning of software developed using RAD is interleaved with writing the software itself. The lack of extensive pre-planning generally allows software to be written much faster, and makes it easier to change requirements. It is focused on building applications in a very short amount of time with compromises in usability, features and execution speed.

Rapid application development is a software development methodology that involves methods like iterative development and software prototyping. According to Whitten (2004), it is a merger of various structured techniques, especially data-driven Information Engineering, with prototyping techniques to accelerate software systems development.

In rapid application development, structured techniques and prototyping are especially used to define users' requirements and to design the final system. The development process starts with the development of preliminary data models and business process models using structured techniques. In the next stage, requirements are verified using prototyping, eventually to refine the data and process models. These stages are repeated iteratively; further development results in a combined business requirements and technical design statement to be used for constructing new systems (Patil et. al., 2005).

RAD approaches may entail compromises in functionality and performance in exchange for enabling faster development and facilitating application maintenance. It promotes strong collaborative atmosphere and dynamic gathering of requirements which is actively participates in prototyping, writing test cases and performing unit testing.

3.2 Implementation of Rapid Application Development (RAD) in CMS Development

Rapid Application Development (RAD) is selected as the evolution of the CMS development methodology so the production of this project can help identify and meet the needs of users from time to time and at the same time, the components of this project can be modified directly. Speed and quality are the primary advantages of Rapid Application.

Among the other factors are:

i. To converge early toward a design acceptable to the customer and feasible for the developers.

ii. To limit a project's exposure to the forces of change

iii. To save development time, possibly at the expense of economy or product quality.

There have four main life cycle phases in the RAD life cycle as refer to Figure 3.1, which is:

a. Requirement Planning
b. User Design
c. Construction
d. Cutover

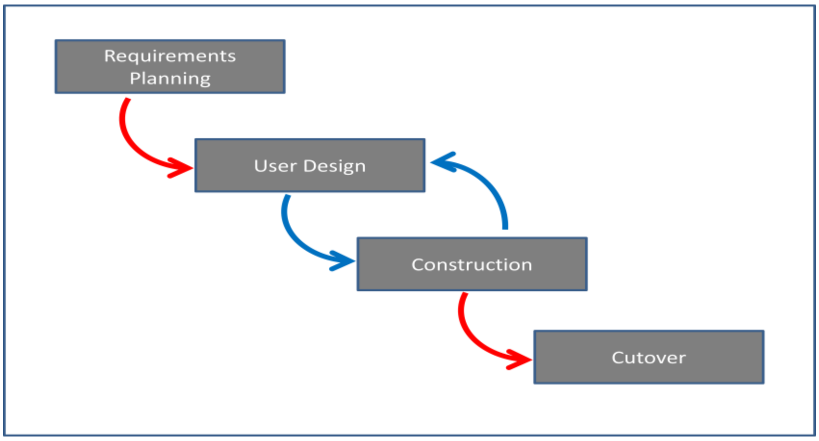


Figure 3.2.1 - Rapid Application Development Lifecycle

3.2.1 Requirement Planning Phase

This phase combines elements of the system planning and systems analysis phases of the System Development Life Cycle (SDLC). In this phase, developer will discuss and agree on project needs, project scope, constraints, and system requirements. It ends when the team agrees on the key issues and obtains management authorization to continue. This stage should result in a list of entities as well as action diagrams that define the interactions between processes and data elements. Ideally requirements should be captured in a structured tool such as Microsoft's Visio , since it can generate databases from a data model. At the end of the Requirements Planning stage project estimation should be considered.

This phase is also where the development needs of the system are been analyzed and finalized. Among the activities involved in this phase is to identify the inputs and outputs required. In addition, planning for system development is also done in this phase.

There are several important processes that will be implemented to achieve the objectives effectively and efficiently. Based on the research that has been made, there is no other product like the CMS in Malaysia that can control the spacing of their parents at a safe distance in case of the missing child's clarification that abound now. In addition, planning for the system development process was also implemented to complete the system within the time stipulated.

3.2.2 User Design Phase

During this phase, users interact with systems analysts and develop models and prototypes that represent all system processes, inputs, and outputs. The RAD groups or subgroups typically translate user needs into working models. User Design is a continuous interactive process that allows users to understand, modify, and eventually approve a working model of the system that meets their needs.

Initial RAD development phase involves planning and designing the RAD model. In this phase, the author draws out the prototype design and produce prototype models. This design is drawn to facilitate to see the prototype design that will be develop later. At this early prototype design, it is developed to see the way of the function of this prototype. Functions in this prototype will start if the distance between children and parents more than 1.5 m. Parent's bracelet signal will start to ring to remind parents of their child's distance. At 1.5 m rates of distance, parents are given two options either to find their children manually or activate a sound signal on their children bracelet which is more quickly and efficiently. At a distance 2.5 m, child's bracelet will emit a sound signal automatically. In this situation, parents will track their children through the sound signal on the bracelet of the child. After the parent's child has been detected, they can stop all the functions on the bracelet manually.

Figure 3.2 gives a logical flow chart of the system. It should be noted that experimental result in later section will confirm this.

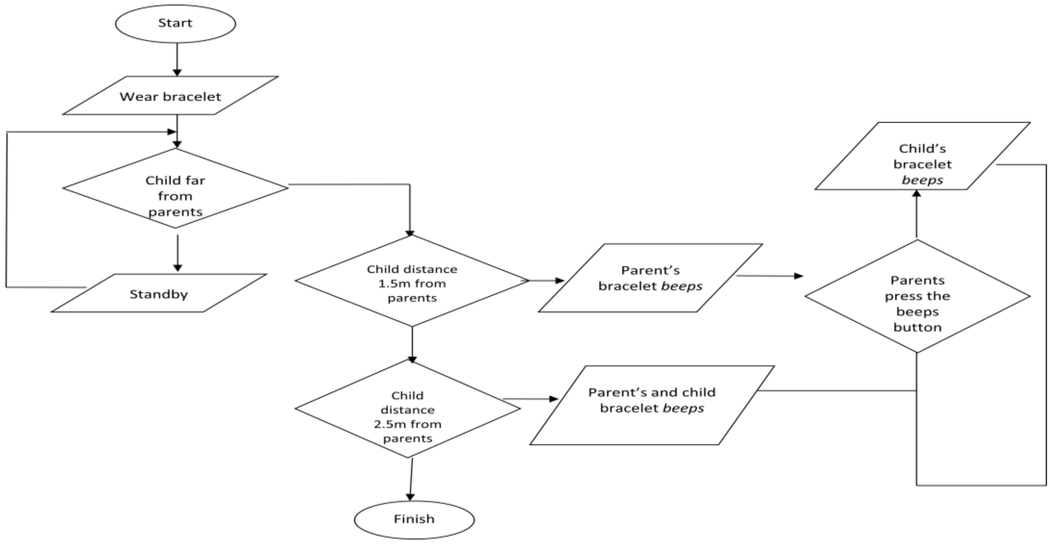


Figure 3.2.2 - Flowchart of CMS system

3.2.2.1 Example

According to IBM Research about Asset Tracking via Robotic Location Crawling (as cited from Asif et. al., 2005), the RFID reader is connected to the client device and records all the tags that it detects movement to different corners of the room. In their experiment, the tagged items were placed at a height of approximately 4ft from the ground. Whenever the reader detects a tag, the client machine sends a message containing the tag's id to the server. The server then notes the current position of the client and associates it with the detected tag. As seen from Figure 3.3, it should be noted that due to the random movement of the robot, consecutive samples for the same tag might not be equally spaced in time.

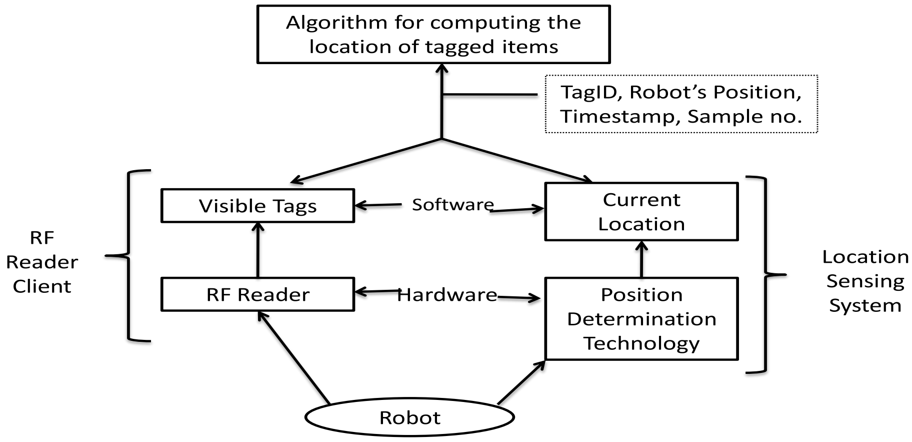


Figure 3.2.3 Flowcart of Robotic Location Crawling system

3.2.2.2 Algorithm

The algorithm for normal parameterization reduction can be defined as the following :

t – represents the tag with id *t*
N_t– is the total number of samples for a given tag, *t*.
(X_{ti}, Y_{ti}) – is the location estimated for sample i of tag *t*
ee_{ti}– is the error estimate for the positioning report for sample i of tag *t*
r – is a constant representing the read radius of the RFID reader.
$R_{ti} = ee_{ti} + r$ - is the radius of the confidence circle for sample *i* for tag *t*.
$C[(X_{ti}, Y_{ti})\ R_{ti}]$ – is the confidence circle for sample *i* for tag *t*.

With these, three algorithm provided to compute the location.

1) Intersection Algorithm: provides a finer estimate of a tag's position. It represents the tag's location as the bounding box of this intersection area. As the number of samples increase, the intersection area also decreased, thus improving the accuracy of the tag's calculated location. The estimate location then is :

$$(X\ ti, Y\ ti) = \text{Centroid}\ (\text{BoundingBox}\ (C[(X\ ti, Y\ t1)\ R\ t1] \cap C[(X\ t2, Y\ t2)\ R\ t2] \cap \ldots \cap C[(X\ Nt, Y\ Nt)\ R\ Nt]))$$

The precision of this algorithm is inversely proportional to the size of the intersection region. Smaller interceptions imply higher probability distribution.

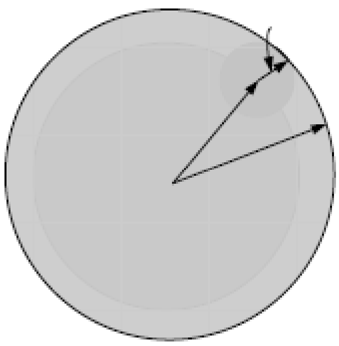


Figure 3.2.4 Total radius is the sum of the reader coverage and the uncertainty circle

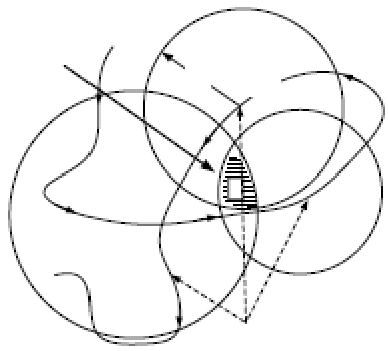


Figure 3.2.5 intersection of the different sample circle converges to the tag location

2) Weighted Averages : Create an algorithm that computes the location coordinates of the tagged entity as aweighted average of the reader's locations when it detected the entity. The weight of each location estimate is inversely proportional to the square of the error radius.

$$(Xt, Yt) = [\ \sum \{\ 1/eei^2 * (Xi, Yi)\ \}\ ]/(\ \sum 1/eei^2)$$

The positioning system's location estimates having a smaller error radius tend to be closer to the tag. Therefore, by using $1/Rt^2$, the algorithm is able to give higher weight to sample points that are close to the tag.

3) Plain Averages : An algorithm that computes the location coordinates of the tagged entity as the statistical average of the reader's location when it detected the entity.

$$(Xt, Yt) = [\ \sum (Xti, Yti)\ ] / Nt$$

The accuracy of this algorithm is similar to weighted average algorithm. However, since this algorithm does not take into account the error estimate of the positioning system, the errors in the estimated location this algorithm will be slightly higher compared to the estimated error for the weighted average.

Before moving to the Construction Phase the developer should focus on next steps by flushing out the project plan and focusing on effort estimates. Focusing on next steps is an important element of the User Design phase, because the initial iteration of the Construction Phase should focus on a feature light prototype.

In order to keep development iterations as short as possible, and to gain the maximum benefit of RAD's agile nature, core requirements should be identified and targeted for the initial prototype, and secondary requirements should be identified and targeted for future development iterations. Beyond a vertical limiting of scope, such as removing entities or use cases from the initial scope, a horizontal type limiting of scope should be considered as well, such as not developing field validation, not developing file upload/download capabilities, or focusing on just the strengths of the particular CASE tool being used without manually adding much developer customization.

3.2.3 Construction Phase

Focuses on program and application development task similar to the SDLC. In RAD, however, users continue to participate and can still suggest changes or improvements as actual screens or reports are developed. Its tasks are programming and application development, coding, unit-integration and system testing.

This construction phase is the phase that involves the customer. At this phase, a the prototype will be provided for testing by the user manual random spots. Lecturers and students will be given the time to test this model and provide feedback on the functionality of this product. Whether this product is function properly, or it needs improvements or changes to enable these products to function more efficient.

3.2.4 Cutover Phase

Resembles the final tasks in the SDLC implementation phase, including data conversion, testing, changeover to the new system, and user training. Compared with traditional methods, the entire process is compressed. As a result, the new system is built, delivered, and placed in operation much sooner. Its tasks are data conversion, full-scale testing, system changeover and user training.

In this phase, the feedback information received from the testing of the developed prototypes will be improved. Negotiations relating to the scope of the product may be required. If there is any change, all phase will be repeated.

3.3 Hardware and Software Tools

For this project, appropriate hardware and software tool should be used in developing this system.

3.3.1 Hardware

The table below lists the hardware tool needed in develops this system.

Table 3.3.1 - Hardware tools

Hardware	**Purpose**
Ultra High Frequency (UHF) Radio Frequency	Device that is used to interrogate an RF signal.
Radio Frequency (RF) Antenna	Catches the signals.
RF transmitter and receiver	RF transmitter send the data signals and then the RF receiver receives that correct data that was sent and sends the data out.
PIC circuit	Microcontroller that allows the programmer instructed the processor what to do with more accurate.
Relay	Switch that operates from an

	electrical signal.
LCD	To display the character
Casing	To cover and protect the circuit that already connected.
Plugin cable/ Power connector	To supply the electric power
PIC downloader	To program the PIC
LED	Notify the signal when the application has been turned on
Buzzer	Emit a sound signal.

Ultra High Frequency (UHF) Radio Frequency

Ultra-high frequency (UHF) designates the ITU radio frequency range of electromagnetic waves between 300 MHz and 3 GHz (3,000 MHz), also known as the decimeter band or decimeter wave as the wavelengths range from one to ten decimeters (10 cm to 1 meter). Radio waves with frequencies above the UHF band fall into the SHF (super-high frequency) and EHF (extremely high frequency) bands, all of which fall into the microwave frequency range. Lower frequency signals fall into the VHF (very high frequency) or lower bands.

The main advantage of UHF transmission is the physically short wave that is produced by the high frequency. The size of transmission and reception antennas is related to the size of the radio wave. The UHF antenna is stubby and short. Smaller and less conspicuous antennas can be used with higher frequency bands.

The major disadvantage of UHF is its limited broadcast range and reception, often called *line-of-sight* between the TV station's transmission antenna and customer's reception antenna, as opposed to VHF's very long broadcast range and reception, which is less restricted by line of sight.

UHF is widely used in two-way radio systems and cordless telephones, whose transmission and reception antennas are closely spaced. UHF signals travel over line-of-sight distances. Transmissions generated by two-way radios and cordless telephones do not travel far enough to interfere with local transmissions. Several public-safety and business communications are handled on UHF. Civilian applications, such as GMRS, PMR446, UHF CB, 802.11b (WiFi) and the widely adapted GSM and UMTS cellular networks, also use UHF cellular frequencies. A repeater propagates UHF signals when a distance greater than the line of sight is required.

Radio Frequency Identification (RFID) Antenna

The antenna in an RF tag is a conductive element that permits the tag to exchange data with the reader. Passive RF tags make use of a coiled antenna that can create a magnetic field using the energy provided by the reader's carrier signal.

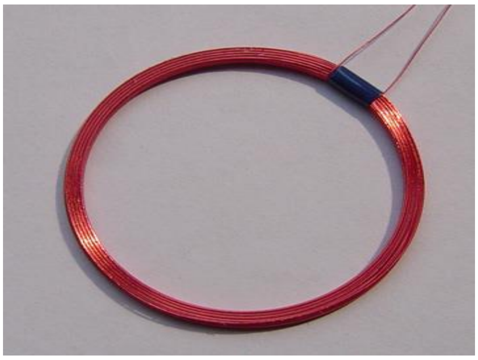


Figure 3.3.1 - RF Antenna Coil

RF transmitter and Receiver

The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434 MHz. An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected. The transmission occurs at the rate of 1Kbps - 10Kbps.The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter.

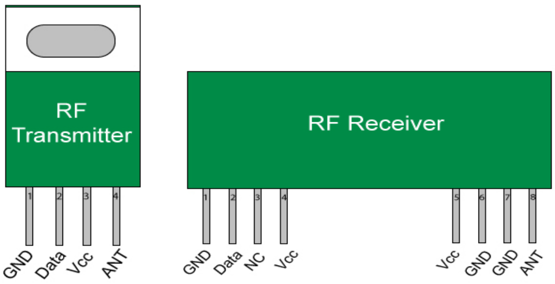


Figure 3.3.2 – RF transmitter and receiver transmitters

Figure 3.3.3 – KH2 series and receivers with integrated encoders and decoders

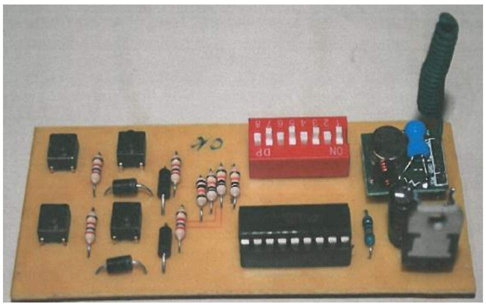


Figure 3.3.4 – RF transmitter circuit

Figure 3.3.5– RF receiver

PIC downloader

The PIC downloader is an in-circuit PIC programmer that delivers operation and simplicity of use. The only connections required are to a host computer via USB and to the target PIC. No external power is required, but the PIC downloader can still deliver current operations to the target. It's robust set of features make it suitable for professional lab and bench top use and production environments.

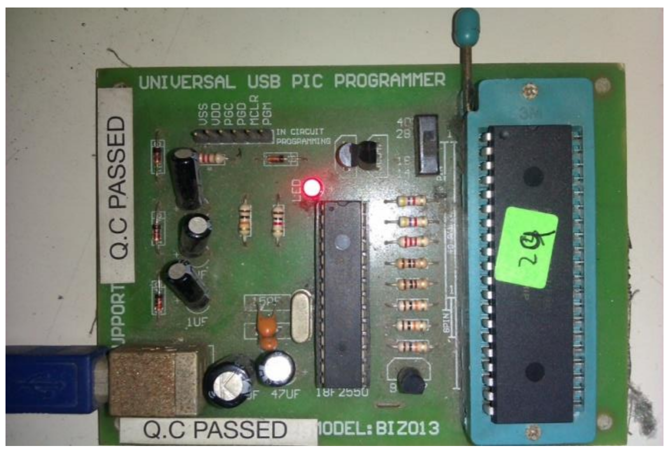


Figure 3.3.6 – PIC downloader

Relay

Relay is a switch, the switch that operates from an electrical signal. Most of the relay using electromagnetic to change the switch or relay contact. There are two types of relay contact that is Normally Open (NO) and Normally Close (NC).

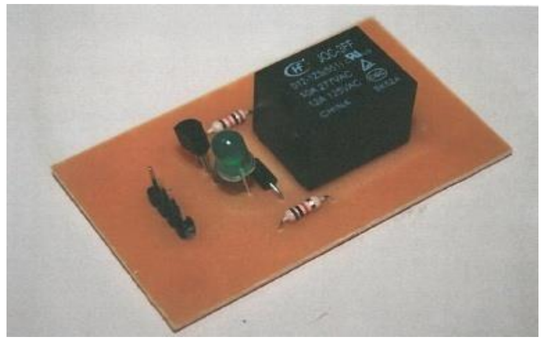


Figure 3.3.7 – Relay Circuit

LED and Buzzer

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices and are increasingly used for other lighting. Introduced as a practical electronic component in 1962, early LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet, and infrared wavelengths, with very high brightness.

Figure 3.3.8 – LED

Figure 3.3.9 – Buzzer

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke. A buzzer is an electro acoustic transducer that produces sound in response to an electrical audio signal input. Non-electrical loudspeakers were developed as accessories to telephone systems, but electronic amplification by vacuum tube made loudspeakers more generally useful. The most common form of loudspeaker uses a paper cone supporting a voice coil electromagnet acting on a permanent magnet, but many other types exist. Where accurate reproduction of sound is required, multiple loudspeakers may be used, each reproducing a part of the audible frequency range. Miniature loudspeakers are found in devices such as radio and TV receivers, and many forms of music players. Larger loudspeaker systems are used for music, sound reinforcement in theatres and concerts, and in public address systems.

3.3.2 Software

The following table concludes software which will be used in order to implement Children Monitoring System (CMS).

Table 3.2 **-**Software tools

Software	**Purpose**
PIC C Compiler	Programming langguage to create the coding for the PIC.
ProSchematic	Schematic drawing program.
Microsoft Office	To make documentation, presentation and project planning

PIC C Compiler

PIC C Compiler provides a complete, integrated tool suite for developing and debugging embedded applications running on Microchip PIC, MCUs and dsPI DSCs. Development tools offered by PIC C Compiler include an optimized C compiler, in-circuit programmers/debuggers, production programmers and complete development kits that contain all hardware, software and accessories needed to jump start your product development.

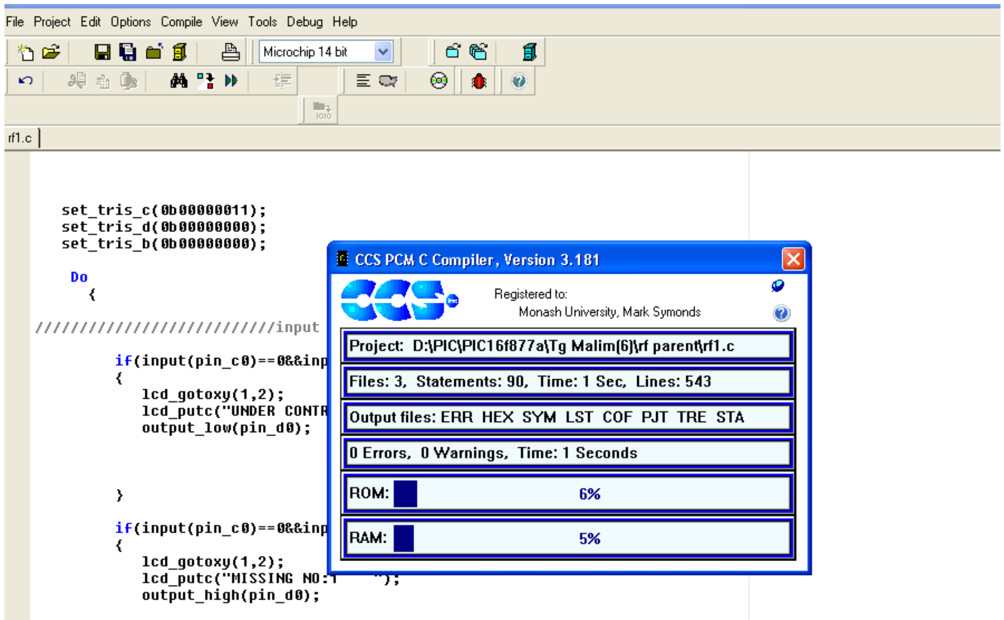


Figure 3.3.10 – PIC C Compiler

ProSchematic

This schematic drawing program is an easy to use schematic capture tool. It is used it to create all the schematics and diagrams for this project.

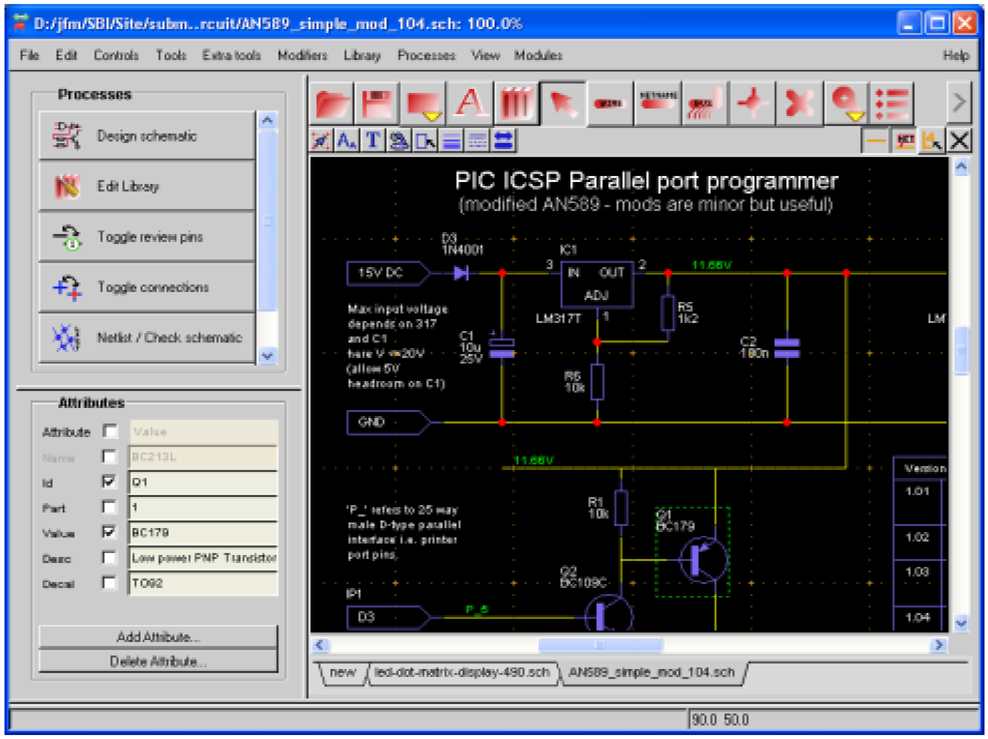


Figure 3.3.11 - ProSchematic

i) Schematic capture: Main buttons

It displays all the main tools as large buttons at the top of the screen and are easier to hit than most other tools with tiny cryptic symbols.

Processes

In addition it has a process box giving you easy access to the functions used in creating a schematic e.g. net listing which also checks the schematic for various errors. Other processes are bill of materials and auto connection dots.

ii) Attributes

The schematic drawing tool shows attribute data which is data associated with a part e.g. the part number R1 or its value 10k but you can also add your own attributes to any part. A useful feature is the attribute display that shows all the data associated with the current part i.e. you don't have to select different menus to see data such as manufacturer part value.

iii) Library

The library has a large selection of components but if a part does not exist then using library editor to create a new part is very simple. The only difference between drawing in the schematic area and drawing a library part is that you can add a pin element all the other controls are identical to the main schematic editor. So if you can draw in the schematic area then you can easily create new parts.

iv) PCB creation

ProSchematic generates a Tango netlist format which you can use to create a pcb. All you have to do is fill in the 'Decal' attribute data and this value is used in generating the netlist

vi) Layers

An unusual feature of the schematic drawing program is that it lets you use layers - normally this feature is used on graphic drawing programs. It's main use here is that you can create background elements that you leave in the backgroundon a different layer and you then set that layer to 'unselectable'. This means you can work on any other part of the drawing without selecting the background. It lets you create the following sort of layout diagrams (this one is from the 12F675 tutorial):

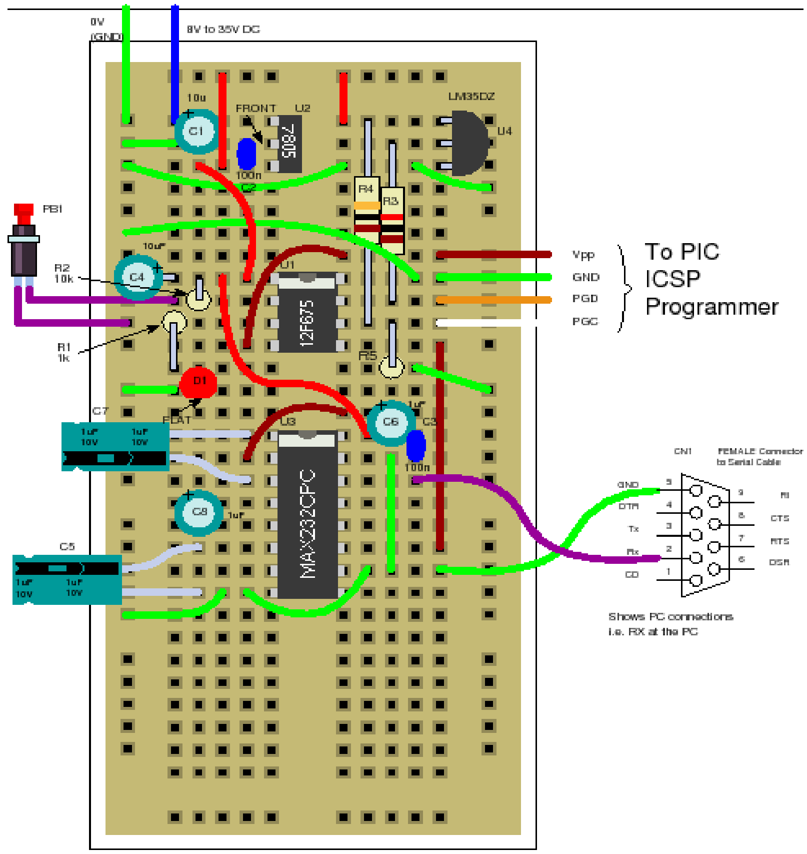


Figure 3.3.12– Example of schematic layout diagram.

Here the solderless breadboard (and each hole) in the solderless breadboard is a schematic item and these are placed into layer 6 while all the other items are on layer 1 so - you can move wires around without affecting the background.

Microsoft Office, Microsoft PowerPoint and Microsoft Project

Microsoft Office is a proprietary commercial office suite of inter-related desktop applications, servers and services for the Microsoft Windows and Mac OS X operating systems, introduced by Microsoft in

August 1, 1989. Initially a marketing term for a bundled set of applications, the first version of Office contained Microsoft Word, Microsoft Excel, and Microsoft PowerPoint. Over the years, Office applications have grown substantially closer with shared features such as a common spell checker, OLE data integration and Microsoft Visual Basic for Applications scripting language. Microsoft also positions Office as a development platform for line-of-business software under the Office Business Applications brand.

Microsoft PowerPoint, usually just called PowerPoint, is a non-free commercial presentation program developed by Microsoft. It is part of the Microsoft Office suite, and runs on Microsoft Windows and Apple's Mac OS X operating system. The current versions are Microsoft Office PowerPoint 2010 for Windows and Microsoft Office PowerPoint 2011 for Mac.

Microsoft Project (MSP, MSOP or WinProj) is a project management software program, developed and sold by Microsoft, which is designed to assist a project manager in developing a plan, assigning resources to tasks, tracking progress, managing the budget, and analyzing workloads.

3.4 Conclusion

Rapid Application Development, the development of higher-quality, cost-efficient software in a fraction of the time, has thus become a necessity as user strives to meet the new demands of the software industry. Developers must embrace this fact by challenging themselves to adopt new, innovative means of meeting consumer demands. Rapid Application

Development, and its use of powerful CASE tools, is such a means. It overcomes the challenges of more, better, and faster. It provides both a framework and the functional tools for achieving successful, accelerated software development. Rapid Application Development is, quite simply, RAD.

CHAPTER IV

IMPLIMENTATION AND TESTING

This chapter briefly discusses the system development of the Children Monitoring System and following by testing on the developed system.

4.1 Implementation

Implementation phase is where the developer begins the coding process to make all the designs to come alive as a proper and fully functioning system. All the diagrams which were concentrated in the earlier chapter for example use case diagram, activity diagram, sequence diagram and finally class diagram would be very much helpful during this implementation phase. Each and every diagram stated has its own advantages in providing the correct path to come up with a good output. The designs will guide the developer accordingly to develop the system based on the planning and minimize the chances of making mistakes. This is a challenging phase as well for any developer.

4.2 Implementation Module

As for the implementation module, each breakdown on the developed system will be discussed and explained using the appropriate screen shots, related coding section with its explanation. This is moved according to the chosen methodology which is SDLC and its phases. In this part, the system will be divided into few smaller sections and the testing will be done as well.

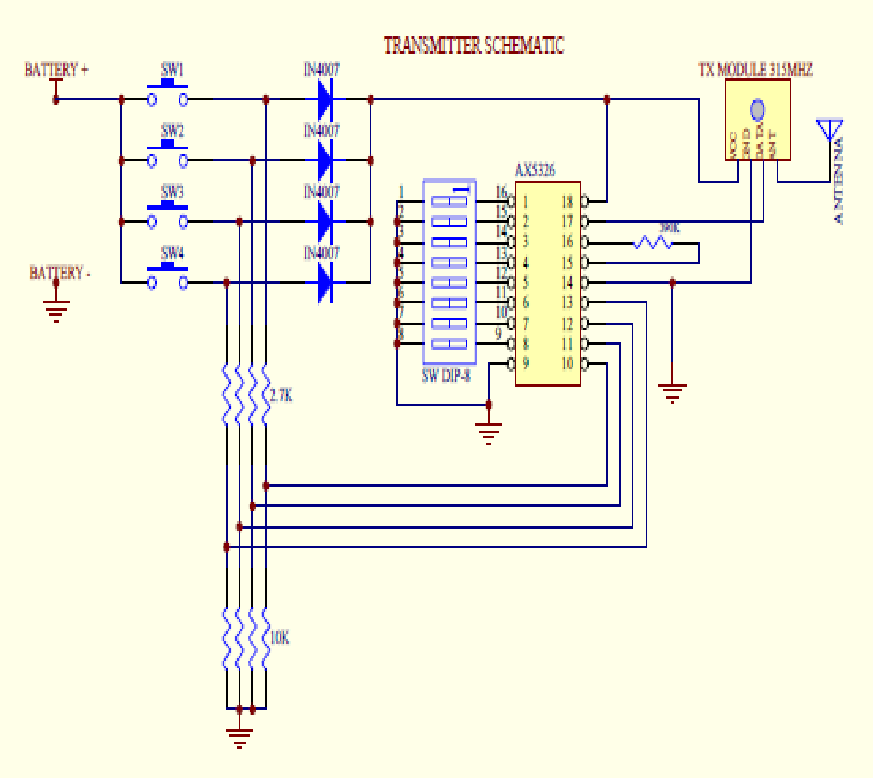
If there are any comments based on the testing, then the system will be looked into again and modification might take place if it is possible within the requirements. There are few modules in this system which is stated below.

- Transmitter Circuit
- Receiver Circuit
- PIC Circuit
- Relay
- LCD

4.2.1 Transmitter and Receiver Circuit

The transmitter/receiver (Tx/Rx) operates at a frequency of 434 MHz. An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected. The transmission occurs at the rate of 1Kbps - 10Kbps. The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter. Firstly, developer should find or design the schematic diagram of the transmitter circuit that match with the project to make sure that all the components and connection are correct so the component can connect to each other that circuit will function. A schematic diagram shows how each component connects with another. It is a simple and easy to read outline of the circuit. Each type of component has a unique symbol and a name (usually 1-2 letters). All relevant values and component specific information are usually included. As you can see figure below, this is the schematic used for transmitter and receiver circuit.

The schematic was draw by using the specific schematic drawing program which is ProSchematic.



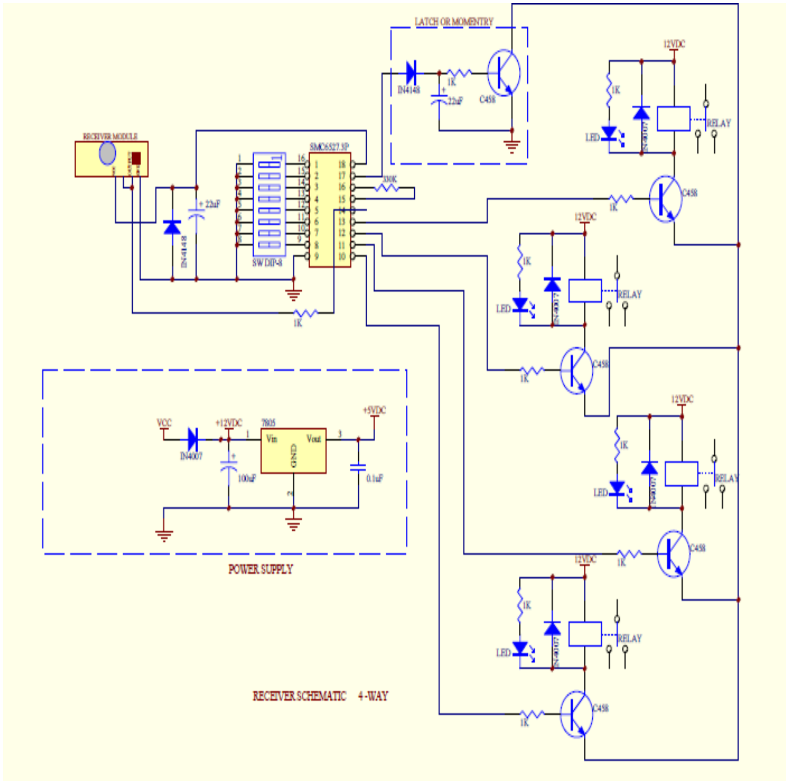
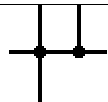
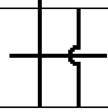
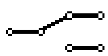
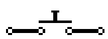
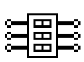
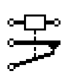
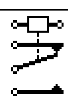
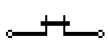
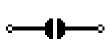
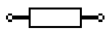
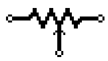
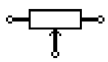
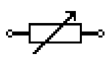
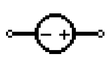
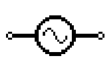


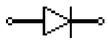
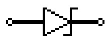
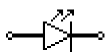
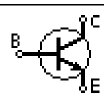
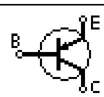
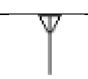
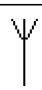
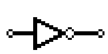
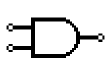
Figure 4.2.1 – Transmitter Schematic

Figure 4.2.2 – Receiver Schematic

Table 4.2.1 – Symbol and meaning used in schematic

Symbol	Component name	Meaning
Wire Symbols		
	Electrical Wire	Conductor of electrical current
	Connected Wires	Connected crossing
	Not connected Wires	Wires are not connected
Switch Symbols and Relay Symbols		
	SPST Toggle Switch	Disconnects current when open
	SPDT Toggle Switch	Selects between two connections
	Pushbutton Switch (N.O)	Momentary switch - normally open
	Pushbutton Switch (N.C)	Momentary switch - normally closed
	DIP Switch	DIP switch is used for onboard configuration
	SPST Relay	Relay open / close connection by an electromagnet
	SPDT Relay	
	Jumper	Close connection by jumper insertion on pins.
	Solder Bridge	Solder to close connection

Resistor Symbols		
	Resistor(IEEE)	Resistor reduces the current flow.
	Resistor (IEC)	
	Potentiometer (IEEE)	Adjustable resistor - has 3 terminals.
	Potentiometer(IEC)	
	Variable Resistor / Rheostat (IEEE)	Adjustable resistor - has 2 terminals.
	Variable Resistor / Rheostat (IEC)	
Inductor / Coil Symbols		
	Inductor	Coil / solenoid that generates magnetic field
	Iron Core Inductor	Includes iron
	Variable Inductor	
Power Supply Symbols		
	Voltage Source	Generates constant voltage
	Current Source	Generates constant current.
	AC Voltage Source	AC voltage source
Diode / LED Symbols		

	Diode	Diode allows current flow in one direction only (left to right).
	Zener Diode	Allows current flow in one direction, but also can flow in the reverse direction when above breakdown voltage
	Light Emitting Diode (LED)	LED emits light when current flows through
Transistor Symbols		
	NPN Bipolar Transistor	Allows current flow when high potential at base (middle)
	PNP Bipolar Transistor	Allows current flow when low potential at base (middle)
Misc. Symbols		
	Buzzer	Produce buzzing sound
Antenna Symbols		
	Antenna / aerial	Transmits & receives radio waves
	Antenna / aerial	
Logic Gates Symbols		
	NOT Gate (Inverter)	Outputs 1when input is 0
	AND Gate	Outputs 1 when both inputs are 1.

4.2.1.1 Transmitter circuit component

1. These is the component needed for transmitter circuit

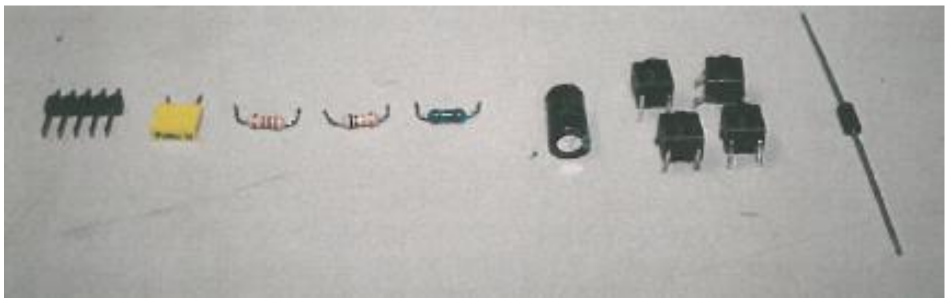


Figure 4.2.1.1 - Transmitter components

From left : Pin header, Cap 0.1 υF, Resistor 2.7k ohm (red-purple-red), Resistor 10k ohm (chocolate-black-orange), Resistor 10M ohm (chocolate-black-blue) 1%, Cap 47 υ F/345v, Switch, Diode IN4007.

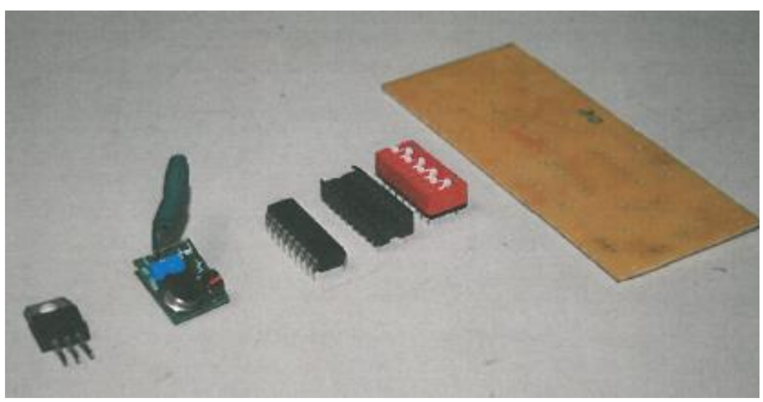


Figure 4.2.1.2 – Transmitter components

From left : 7895, Transmitter module 315Mhz, HT12e, Ic socket 18n pin, Dip switch 8 way.

4.2.1.1 Transmitter circuit configuration steps.

1. Take the Transmitter Circuit.

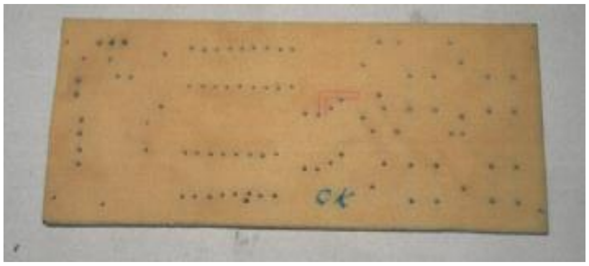


Figure 4.2.1.3

2. Insert the jumper.

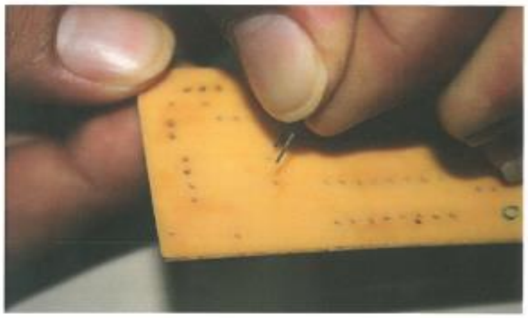


Figure 4.2.1.4

3. Jumper position is as shown below.

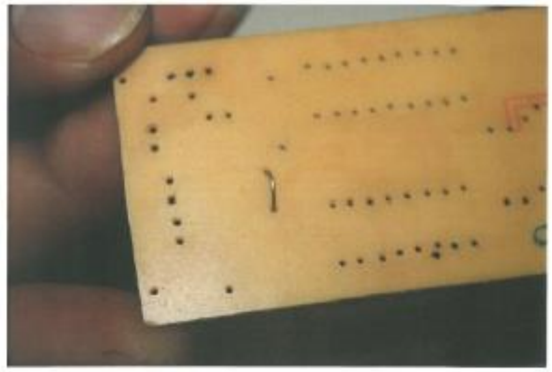


Figure 4.2.1.5

4. Solder that jumper.

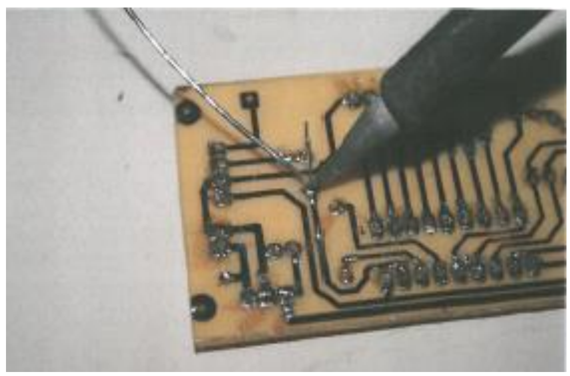


Figure 4.2.1.6

5. Insert the Resistor 10M ohm (chocolate-black-blue) 1%

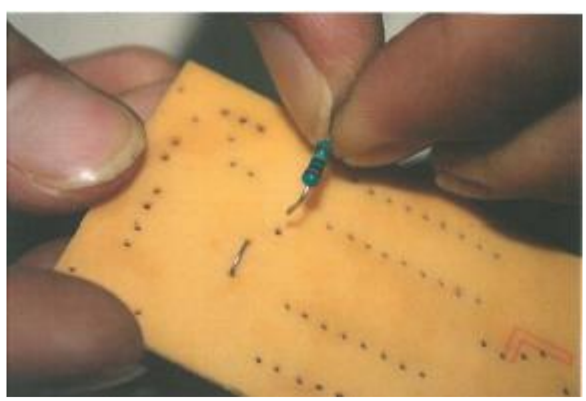


Figure 4.2.1.7

6. Solder that Resistor 10M ohm (chocolate-black-blue) 1%

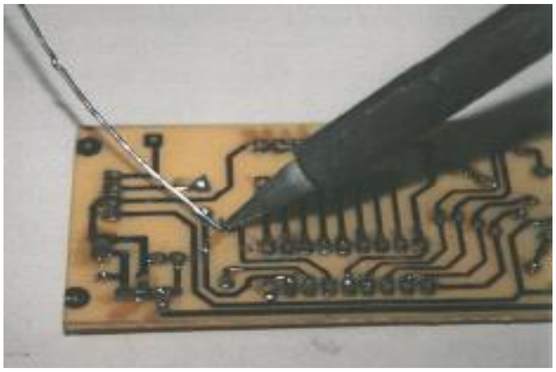


Figure 4.2.1.8

7. Insert the Resistor 10K (chocolate-black-orange)

Figure 4.2.1.9

8. Resistor position is as shown below.

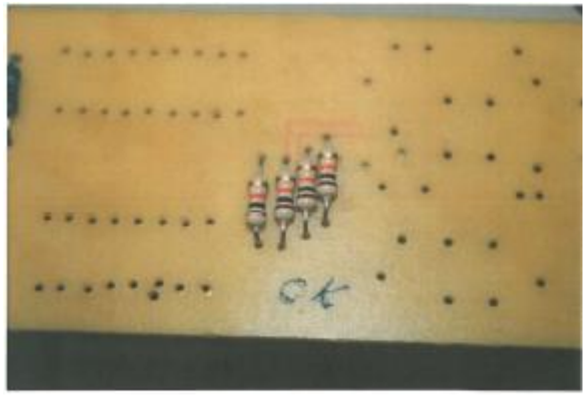


Figure 4.2.1.10

9. Solder that Resistor.

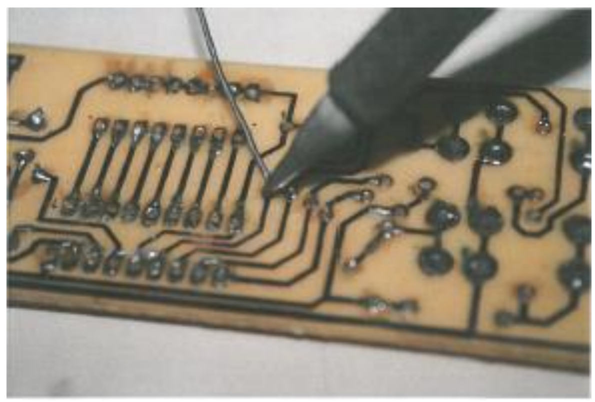


Figure 4.2.1.11

10. Insert the Resistor 2.7k ohm (red-purple-red)

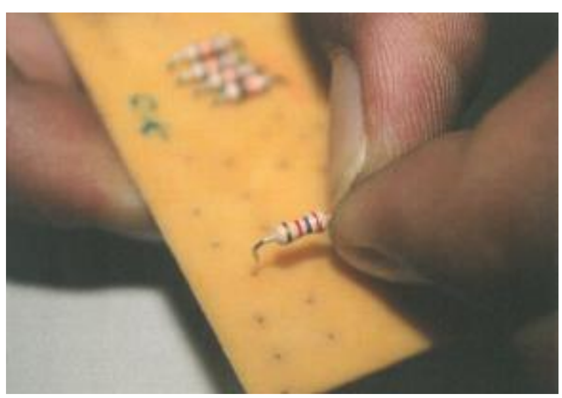


Figure 4.2.1.12

11. Resistor position is as show below.

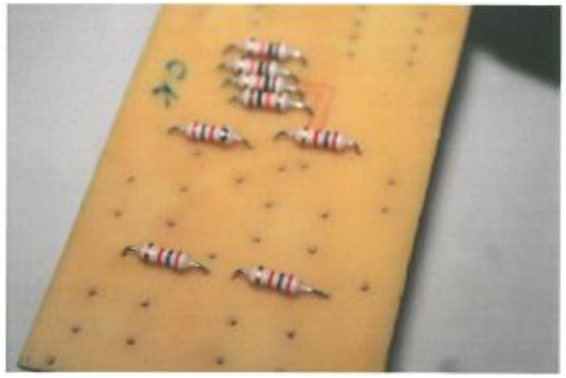


Figure 4.2.1.13

12. Solder that resistor.

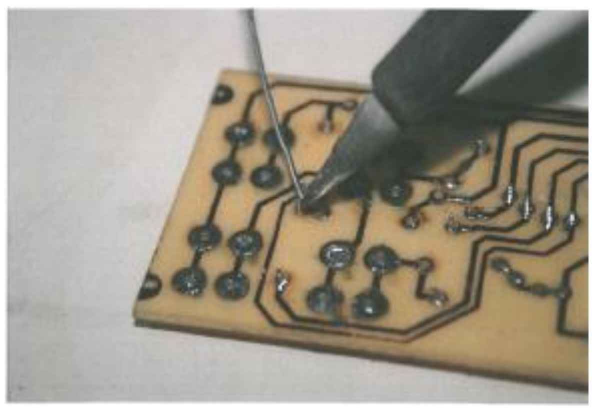


Figure 4.2.1.14

13. Insert the Diode In4007

Figure 4.2.1.15

14. Diode position is as shown below.

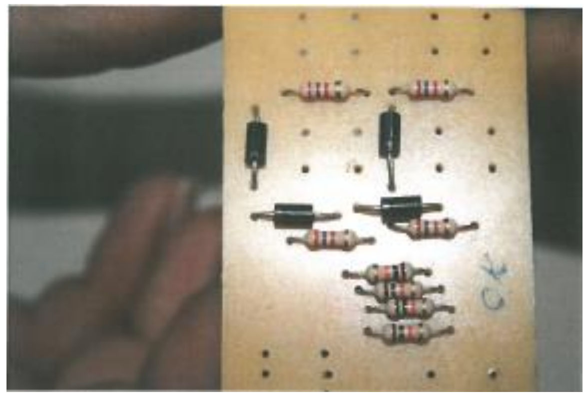


Figure 4.2.1.16

15. Solder that Diode In4007.

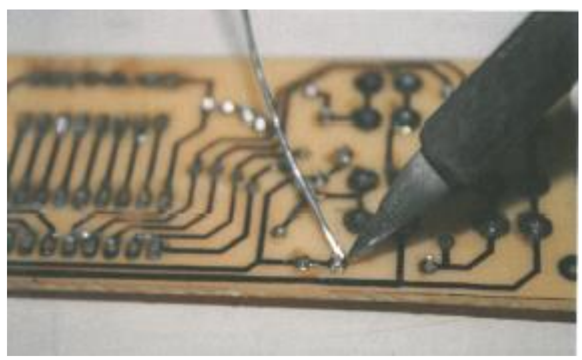


Figure 4.2.1.17

16. Insert the switch.

Figure 4.2.1.18

17. Switch position is as shown below.

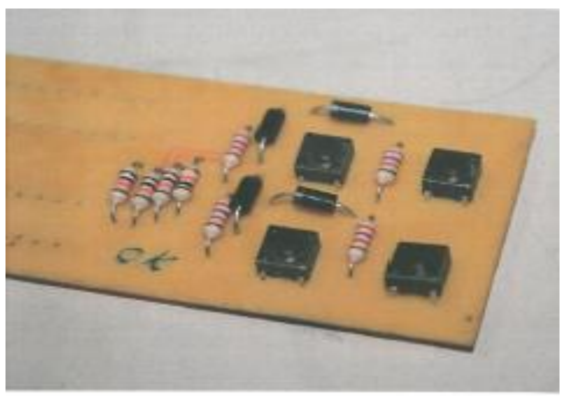


Figure 4.2.1.19

18. Solder that switch.

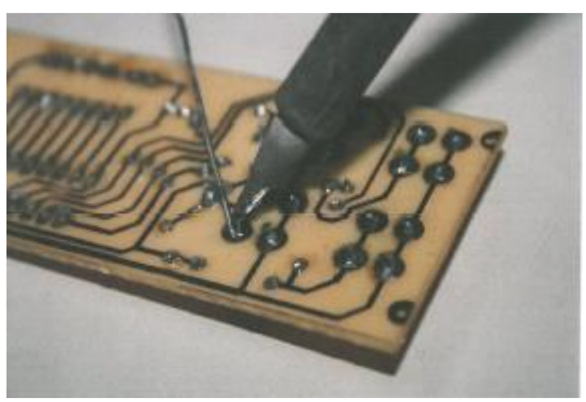


Figure 4.2.1.20

19. Insert the Cap 0.1uF.

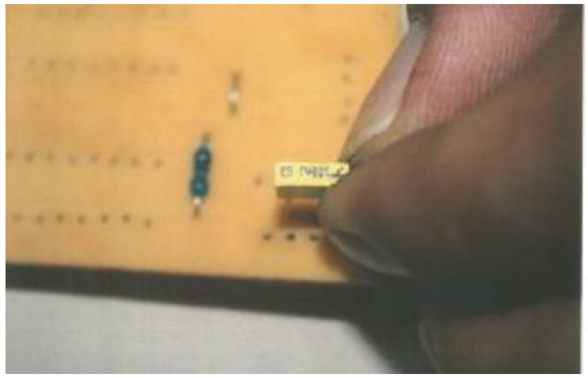


Figure 4.2.1.21

20. Solder that Cap.

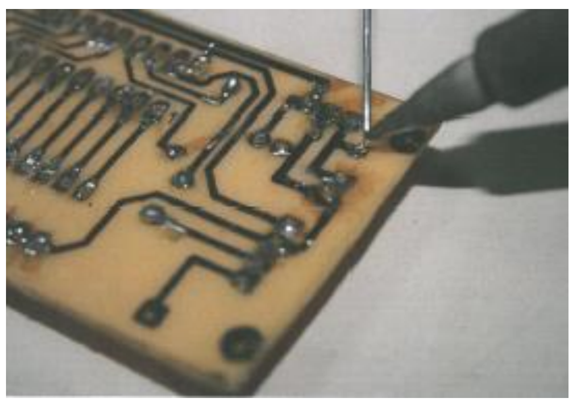


Figure 4.2.1.22

21. Insert the Pin header.

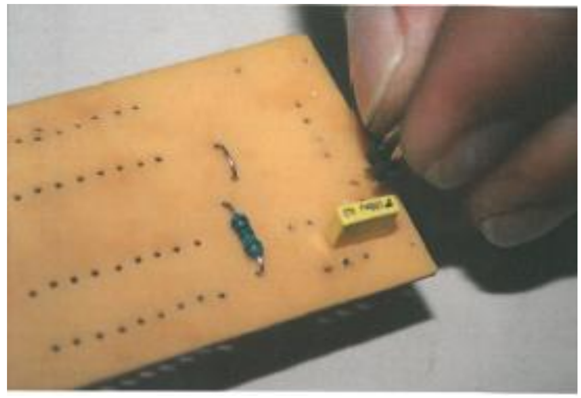


Figure 4.2.1.23

22. Solder that pin header.

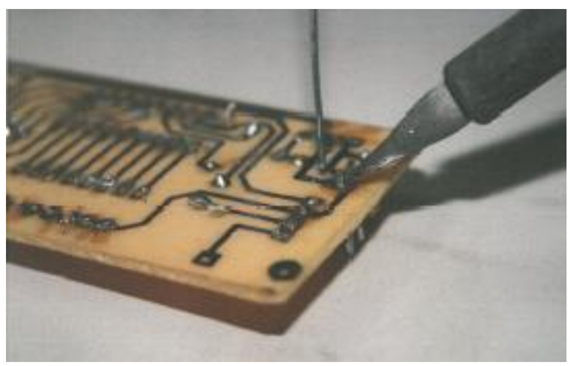


Figure 4.2.1.24

23. Insert the Ic socket.

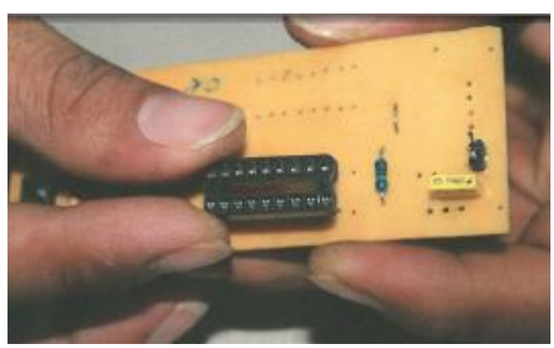


Figure 4.2.1.25

24. Solder that Ic socket.

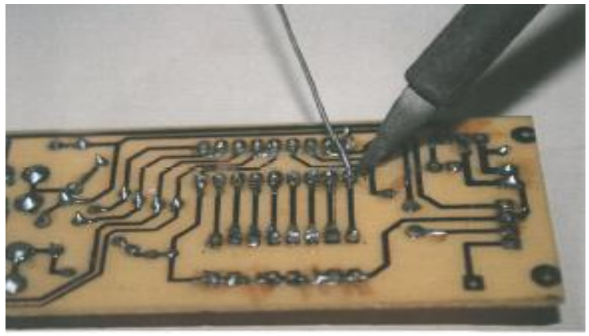


Figure 4.2.1.26

25. Insert the Ic HT12E at the Ic socket.

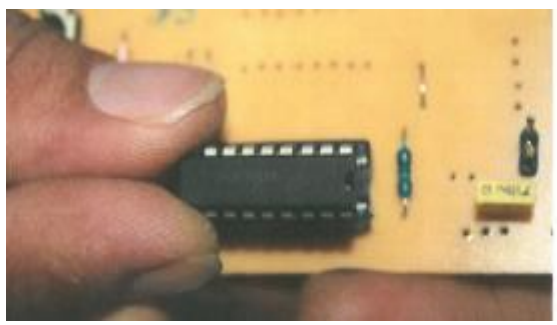


Figure 4.2.1.27

26. Insert the Dip switch 8 way.

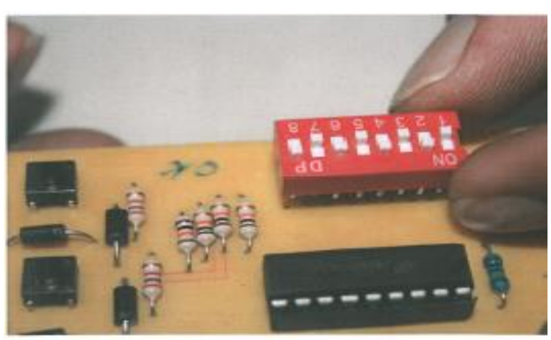


Figure 4.2.1.28

27. Dip switch position is as shown below.

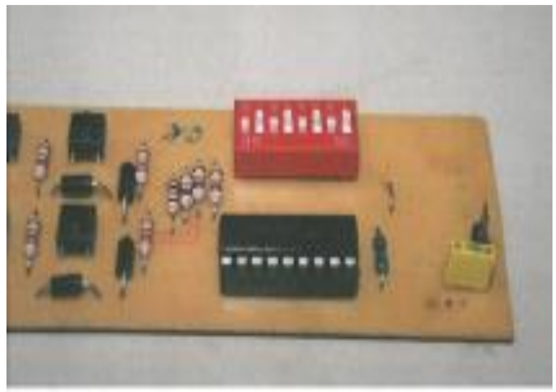


Figure 4.2.1.29

28. Solder that Dip switch.

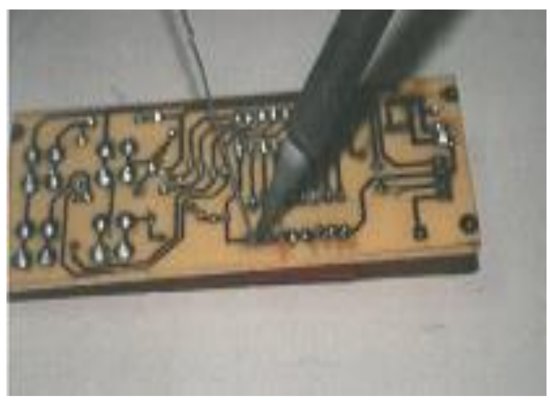


Figure 4.2.1.30

29. Insert the Cap 47 uF/35V.

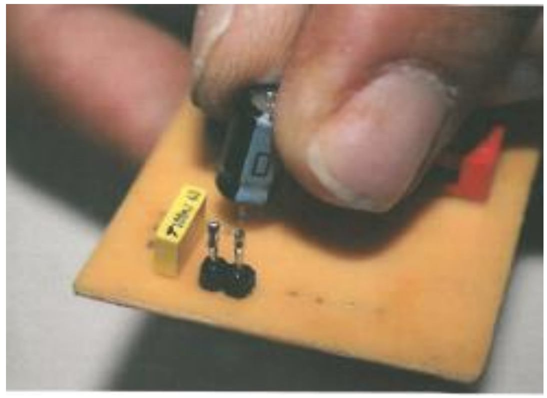


Figure 4.2.1.31

30. Cap 47 uF/35V position is as shown below.

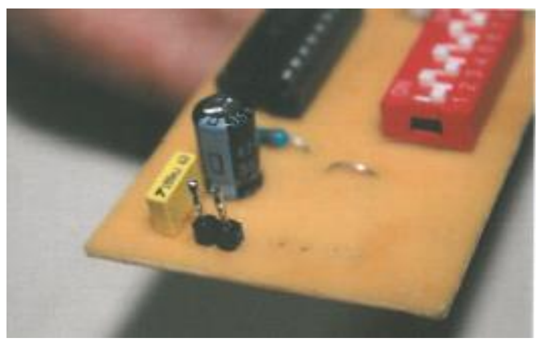


Figure 4.2.1.32

31. Solder that Cap 47 uF/35V.

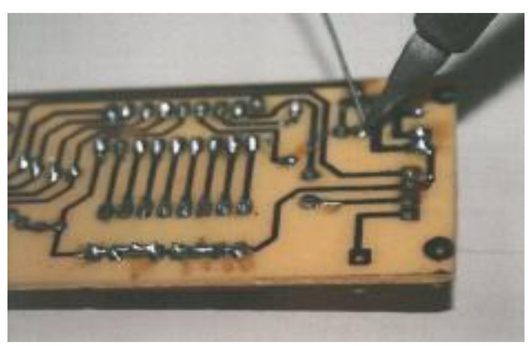


Figure 4.2.1.33

32. Insert the 7805.

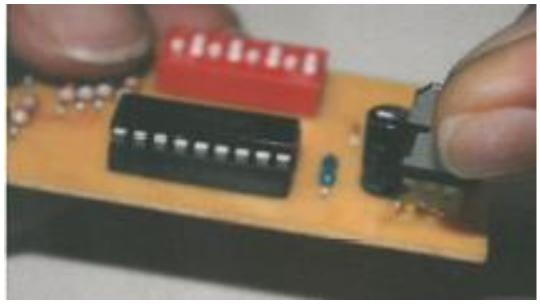


Figure 4.2.1.34

33. 7805 position is as shown below.

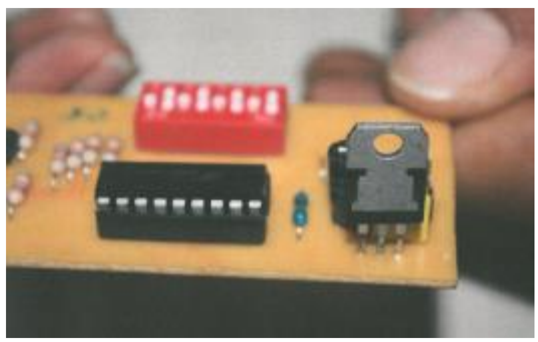


Figure 4.2.1.35

34. Solder that 7805.

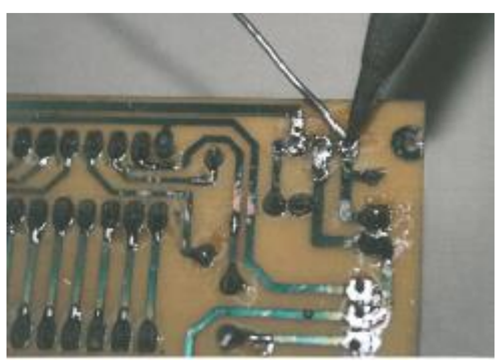


Figure 4.2.1.36

35. Insert the transmitter module.

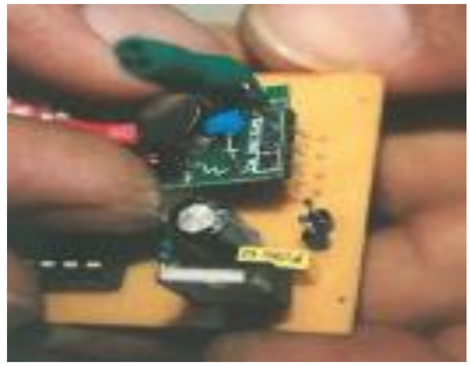


Figure 4.2.1.37

36. Solder that transmitter module.

Figure 4.2.1.38

37. Transmitter Circuit is as shown below.

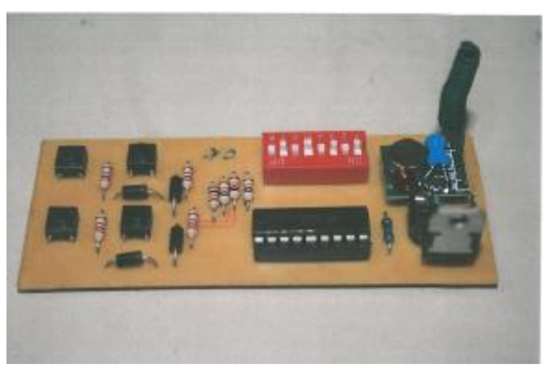


Figure 4.2.1.39

4.2.1.2 Receiver circuit component

1. These is the component needed for receiver circuit

Figure 4.2.1.40 – Receiver components

From left : 7805, Capacitor 0.1 uF, Transistor 2N2222, Dip Switch 8 way, HT12D, 18 Pin Ic Socket and Receiver Module.

Figure 4.2.1.41 – Receiver components

From left : Pin Header, Cap 47uF/35V, Resistor 51k ohm 1%, Resistor 1k ohm (chocolate-black-red), Diode IN4007 and Receiver Circuit.

4.2.1.3 Receiver circuit configuration steps.

1. Take the Receiver Circuit.

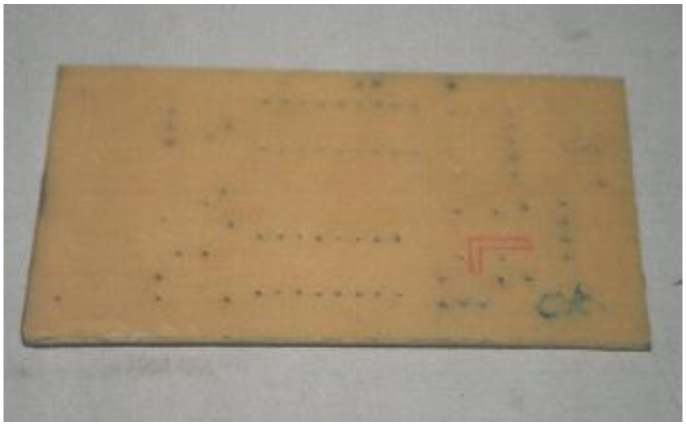


Figure 4.2.1.42

2. Insert two jumpers.

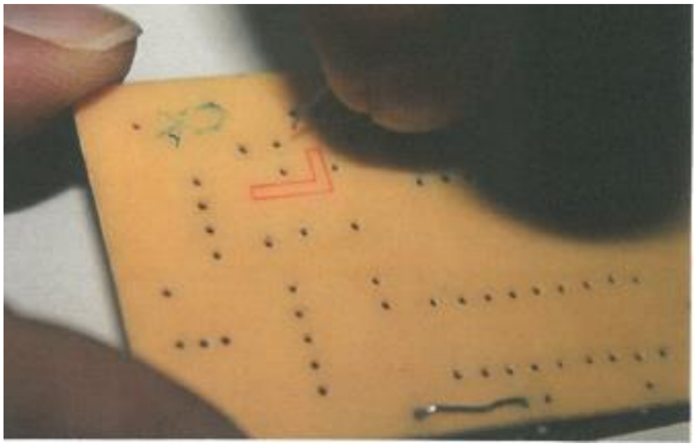


Figure 4.2.1.43

3. Solder those two jumpers.

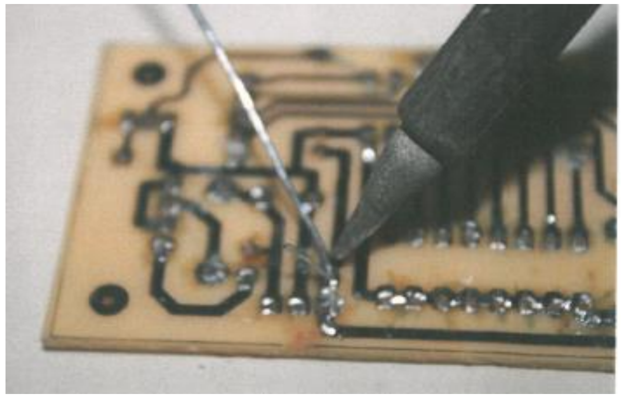


Figure 4.2.1.44

4. Jumper position is as shown below.

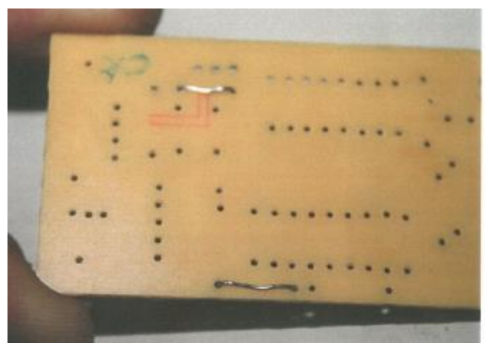


Figure 4.2.1.45

5. Insert Resistor 1k ohm (chocolate-black-orange)

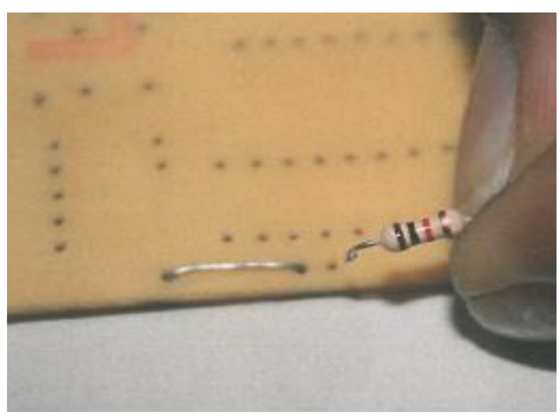


Figure 4.2.1.46

6. Insert the resistor 51k ohm 1%

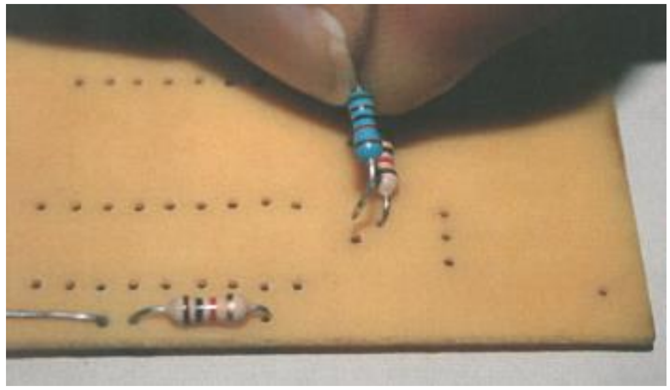


Figure 4.2.1.47

7. Solder the resistor.

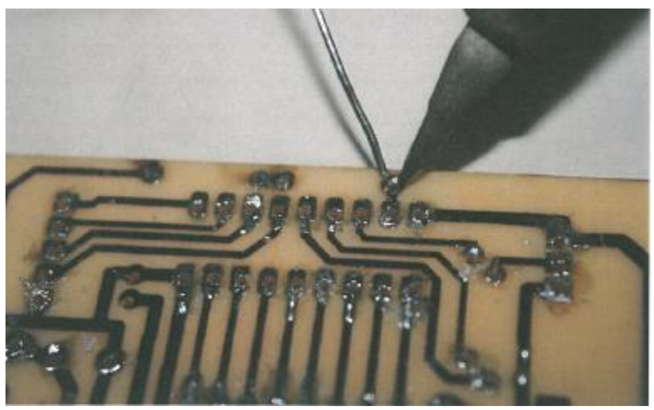


Figure 4.2.1.48

8. The resistor position is as shown below.

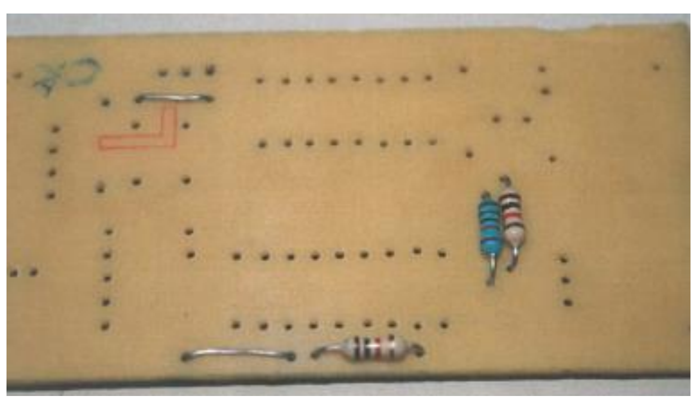


Figure 4.2.1.49

9. Insert the Diode IN4007.

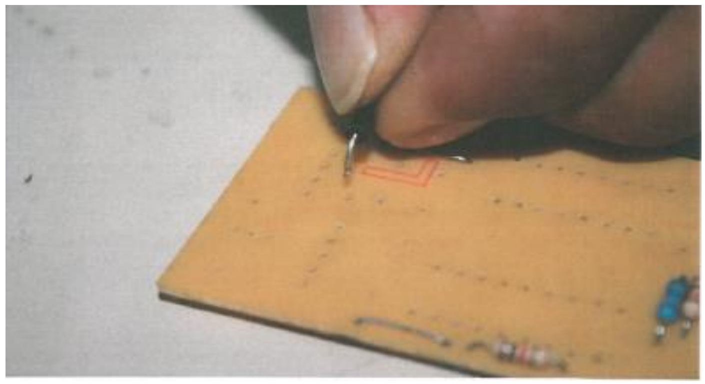


Figure 4.2.1.50

10. Solder that Diode.

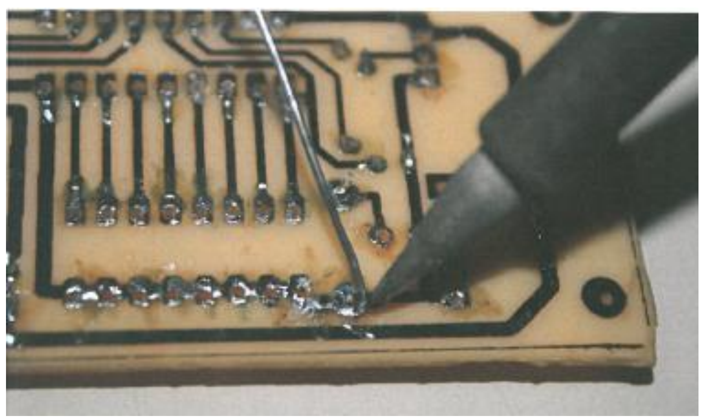


Figure 4.2.1.51

11. Insert the Transistor NPN 2N2222.

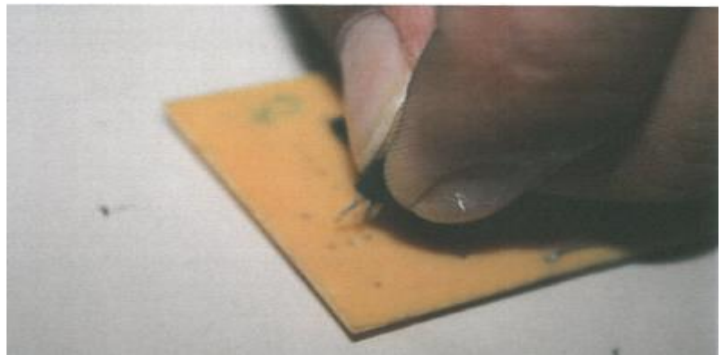


Figure 4.2.1.52

12. Solder that Transistor.

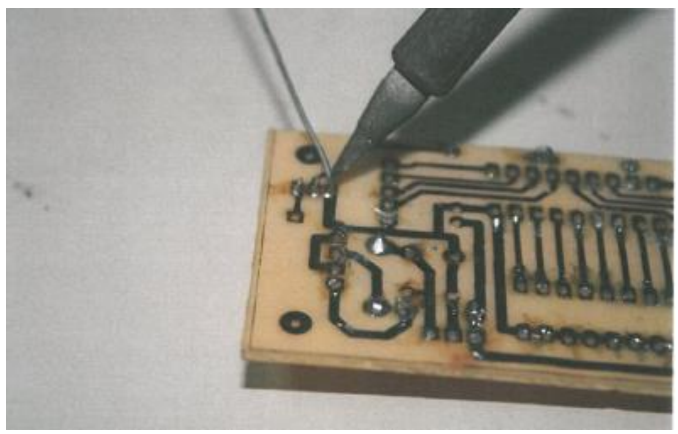


Figure 4.2.1.53

13. Resistor and transistor position is as shown below.

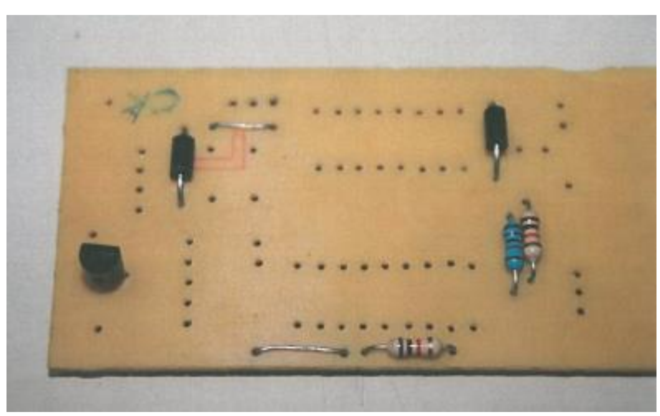


Figure 4.2.1.54

14. Insert the pin header.

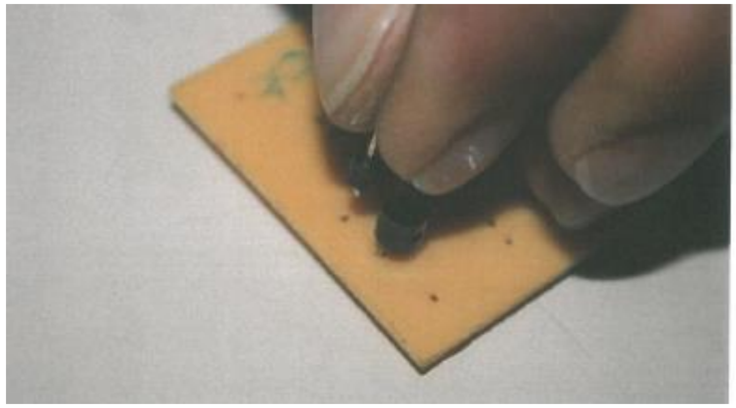


Figure 4.2.1.55

15. Solder that pin header.

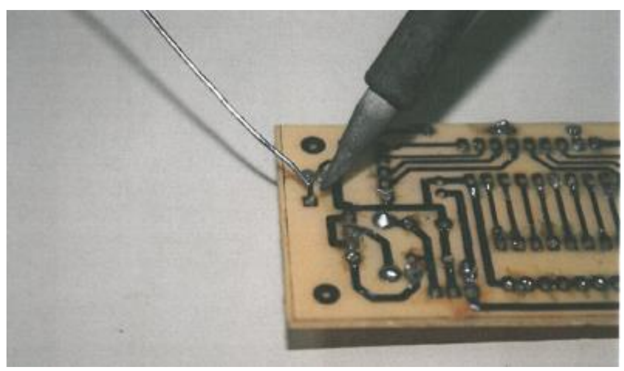


Figure 4.2.1.56

16. Insert Cap 0.1uF

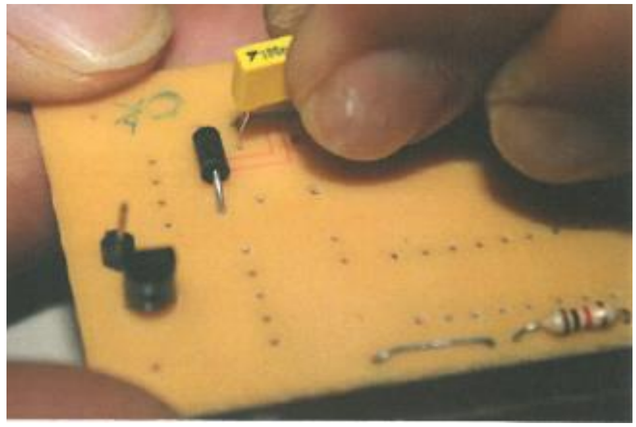


Figure 4.2.1.57

17. Solder that Cap 0.1 uF.

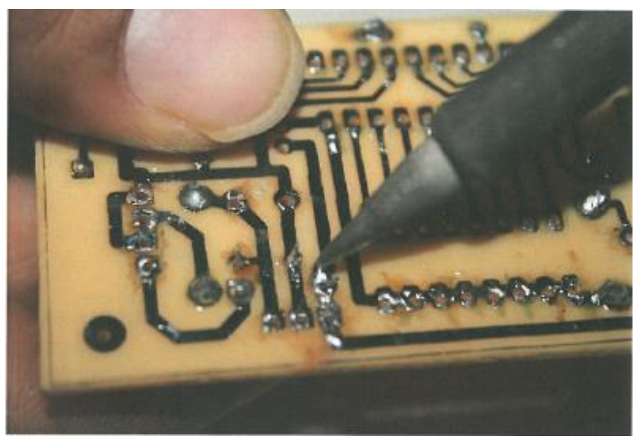


Figure 4.2.1.58

18. Cap position is as shown below.

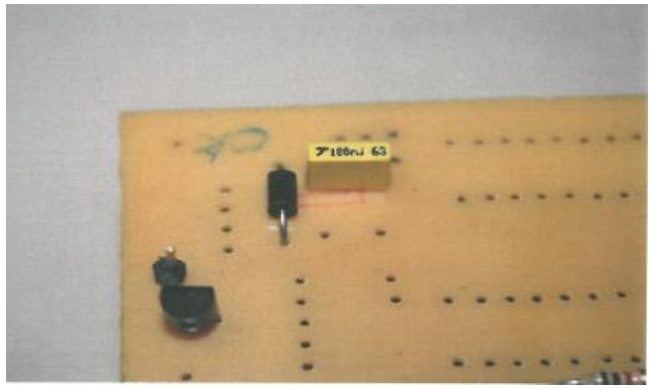


Figure 4.2.1.59

19. Insert pin header.

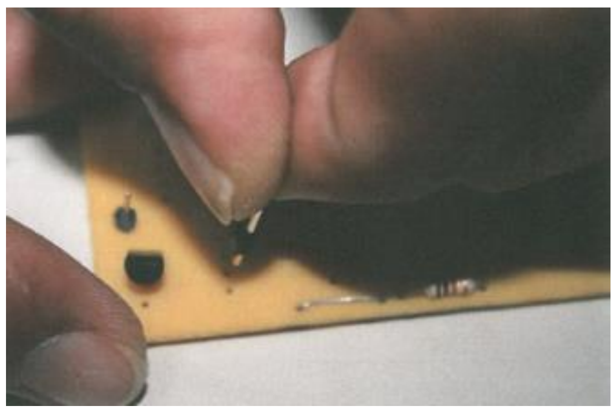


Figure 4.2.1.60

20. Solder that pin header.

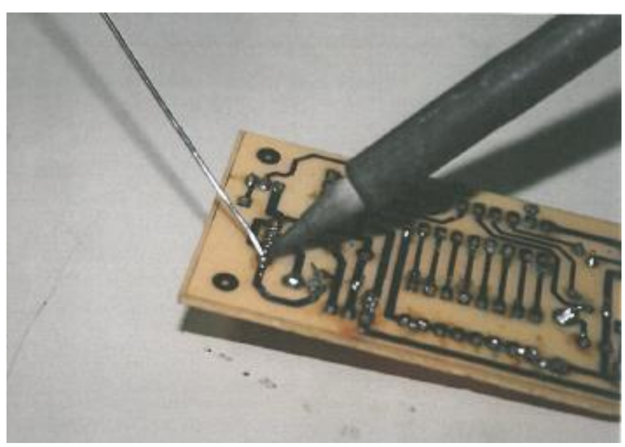


Figure 4.2.1.61

21. Pin header position is as shown below.

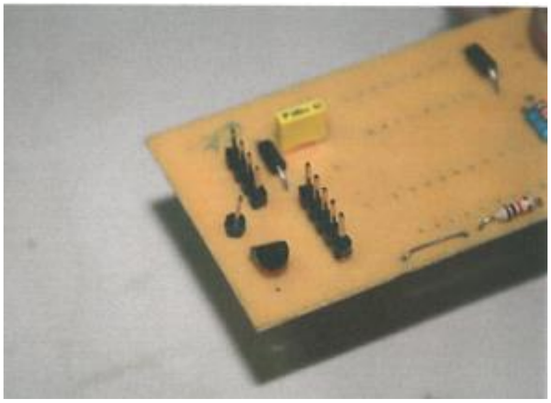


Figure 4.2.1.62

22. Insert the Ic socket.

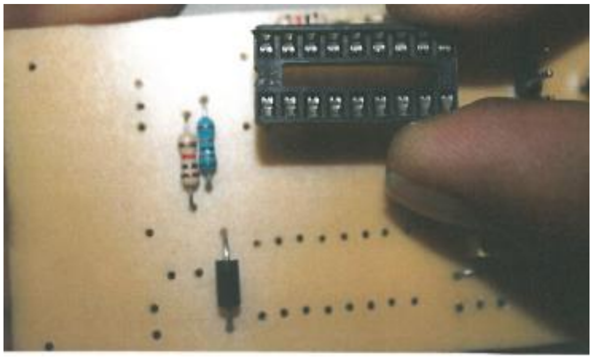


Figure 4.2.1.63

23. Ic socket will looks as shown below.

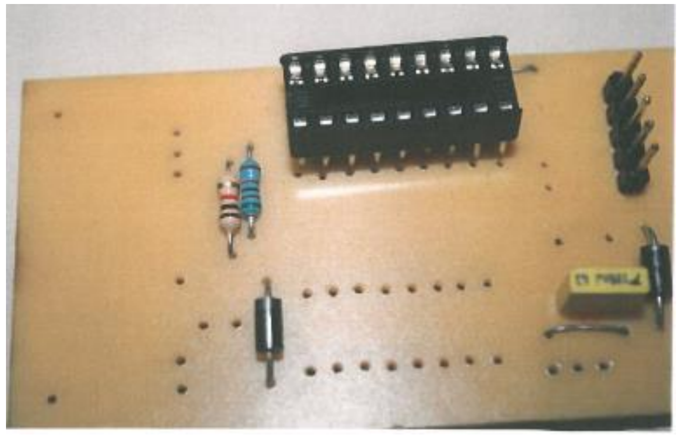


Figure 4.2.1.64

24. Solder that Ic socket.

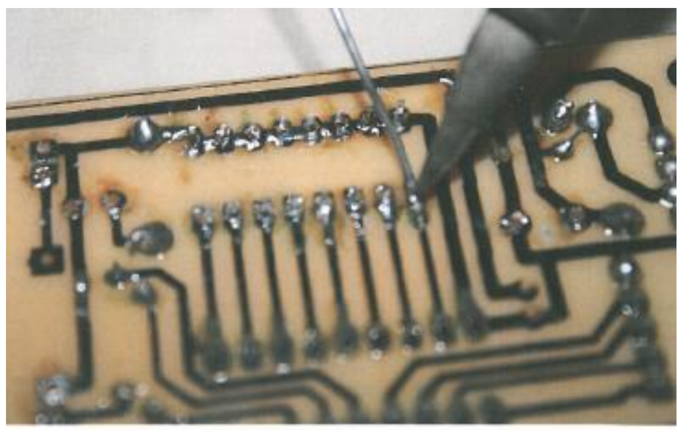


Figure 4.2.1.65

25. Insert Ic HT12D.

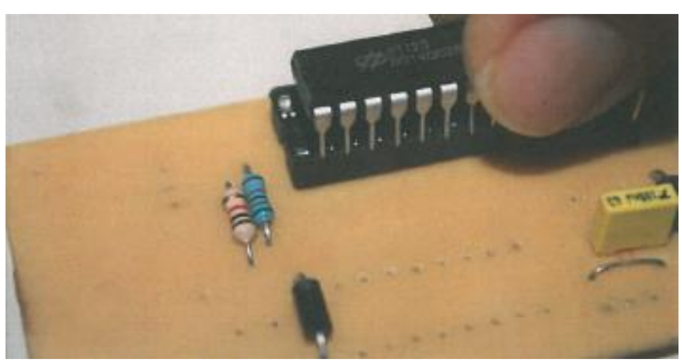


Figure 4.2.1.66

26. Insert Dip switch.

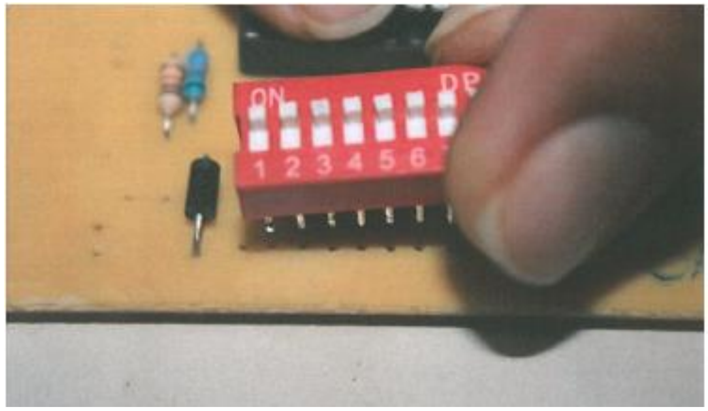


Figure 4.2.1.67

27. Solder that Dip switch.

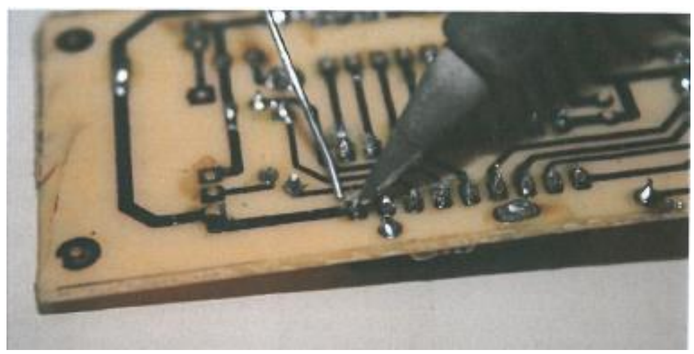


Figure 4.2.1.68

28. Dip switch will looks as shown below.

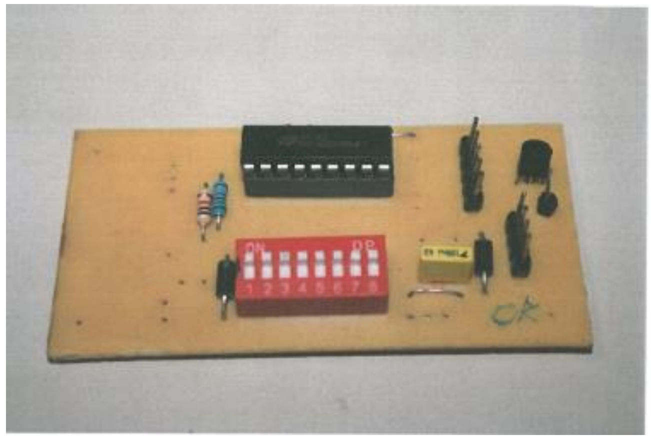


Figure 4.2.1.69

29. Insert the Cap 47 uF.

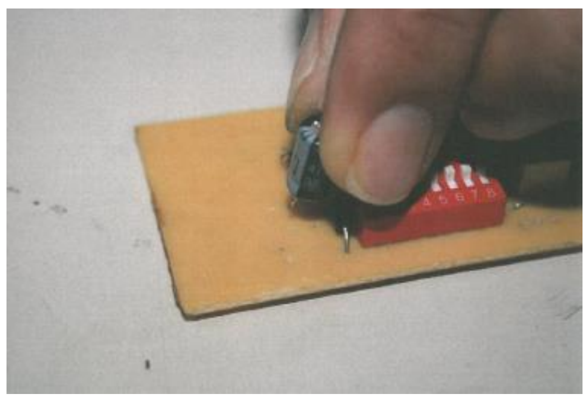


Figure 4.2.1.70

30. Solder the Cap 47 uF.

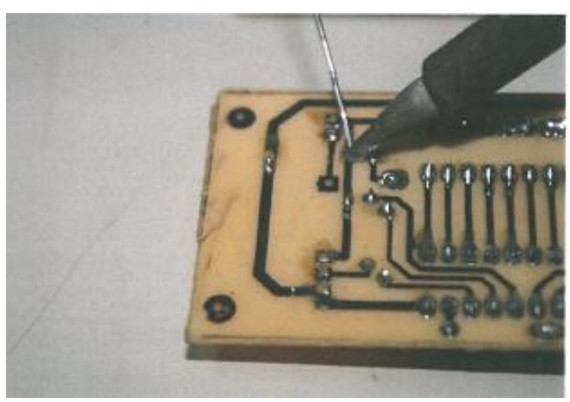


Figure 4.2.1.71

31. Cut little bit wire and solder that wire ass shown below.

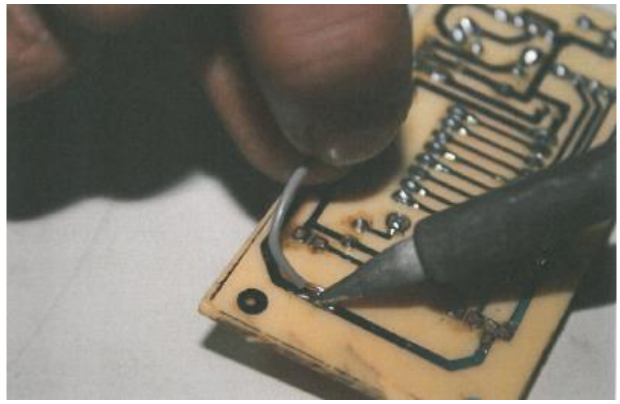


Figure 4.2.1.72

32. Insert 7805.

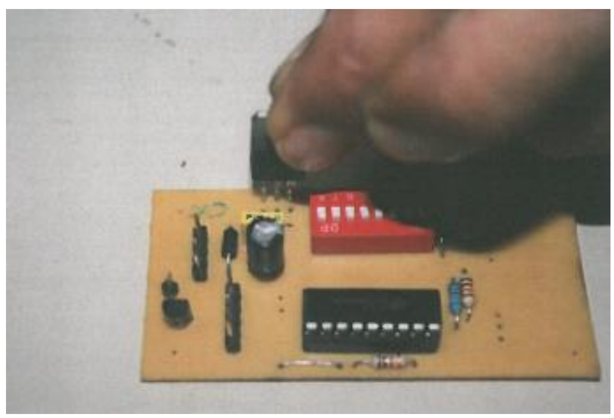


Figure 4.2.1.73

33. Solder that 7805.

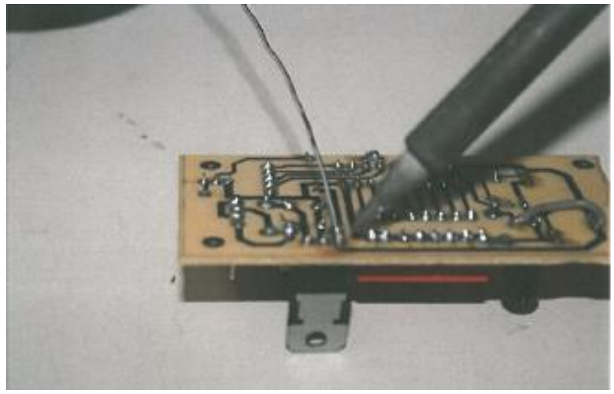


Figure 4.2.1.74

34. Insert Receiver module 315MHz.

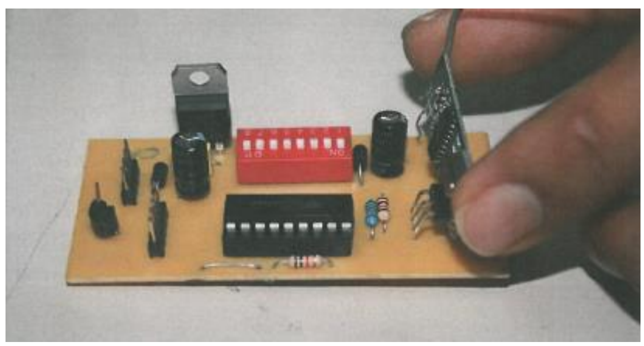


Figure 4.2.1.75

35. Solder that module.

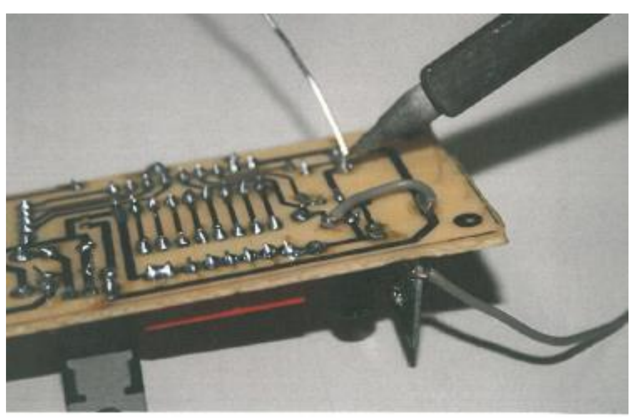


Figure 4.2.1.76

36. Receiver Circuit is as shown below.

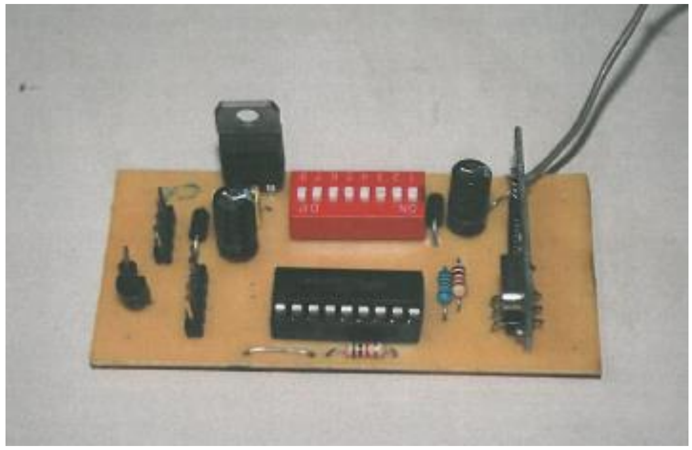


Figure 4.2.1.77

4.2.2 PIC Circuit

PIC is a microcontroller which is product by Microchip Technology. PIC is popular because it is low price. Developer can use assembly language or C language to program the PIC. Using assembly language allows programmers tell what processor task more accurately. Therefore, the program will become faster and more compact. The use of memory in the PIC is less than if using the C language. C compiler needed when using the C language. There are many compilers for the PIC. Using the C language is also easier to understand than assembly language.

Among the features available on this PIC is I / O Ports, Timer, Pulse Width Modulation (PWM) Module, Master Synchronous Serial Port (MSSP) Module, addressable Universal Synchronous Asynchronous Receiver Transmitter (USART), Analog-to-Digital Converter (ADC) Module and Comparator Module. Below shown the schematic for PIC16F877A that used in this project:

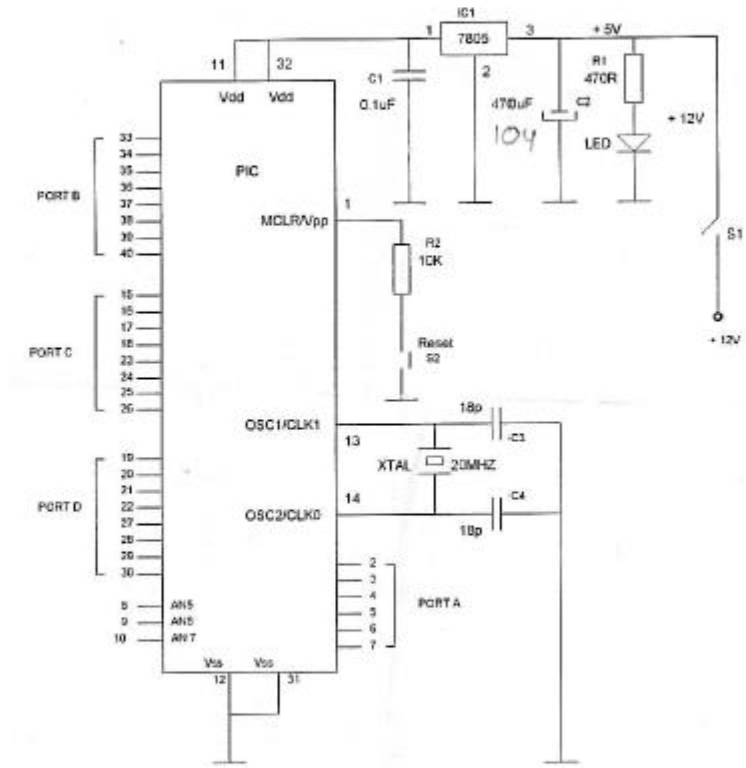


Figure 4.2.2.1 – PIC schematic

To download the programming into PIC, developer can use PIC downloader.

Firstly, connect circuit using PIC downloader, then compile the example of code using the PIC C compiler and load the program onto the PIC. After that, turn on the power to run the program. Actually, PIC can be referring as main controller that controls every process in the project. So developer must make sure that every connection/programming is tested properly. Input and output that display on LCD also are programmed into PIC. Every circuit and component is connected to each other through PIC as shown below.

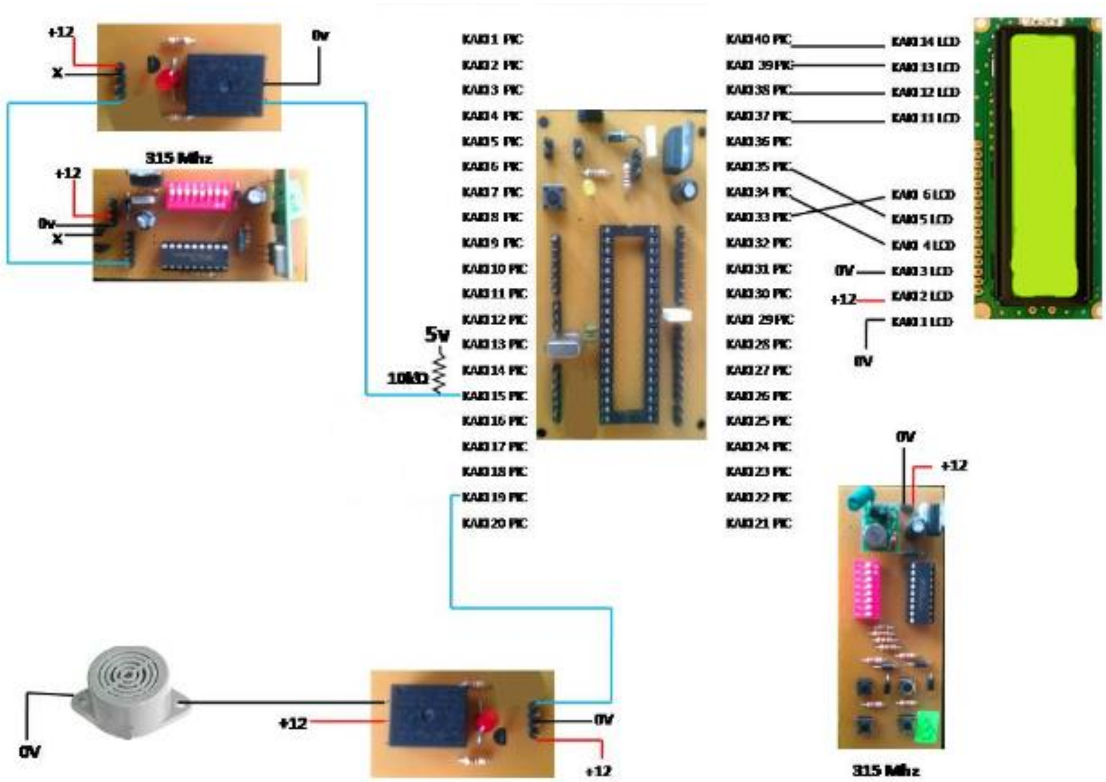


Figure 4.2.2.2 – Layout for PIC and others circuit.

4.2.2.1 How to program the PIC

By using PIC downloader, PIC is connected to the computer then to download programming code into PIC. PIC C Compiler is used for this project. Below are the interface when download the programming code into PIC.

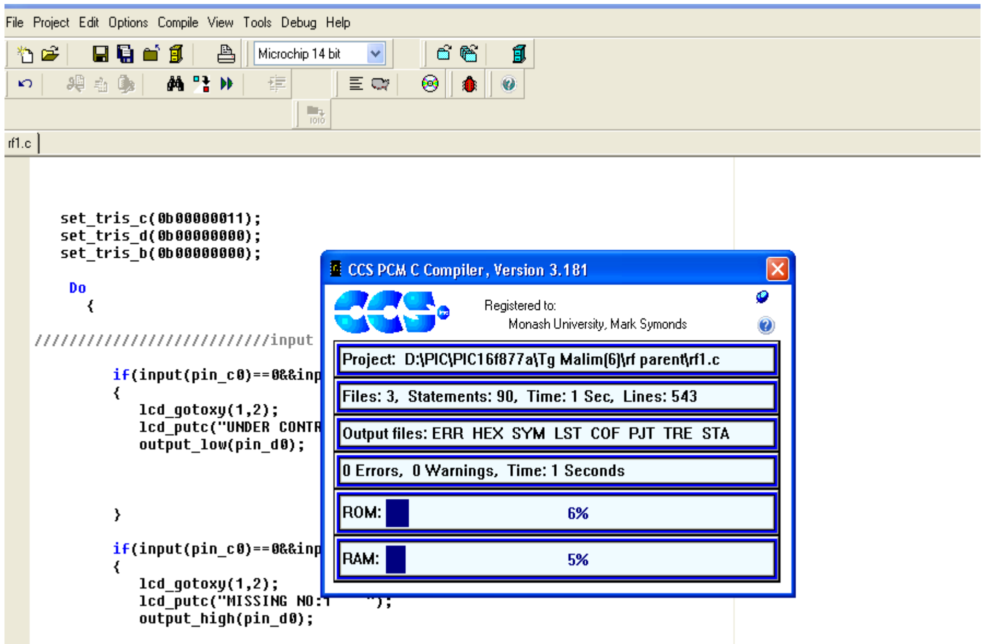


Figure 4.2.2.3 – PIC C Downloader interface when download coding into PIC

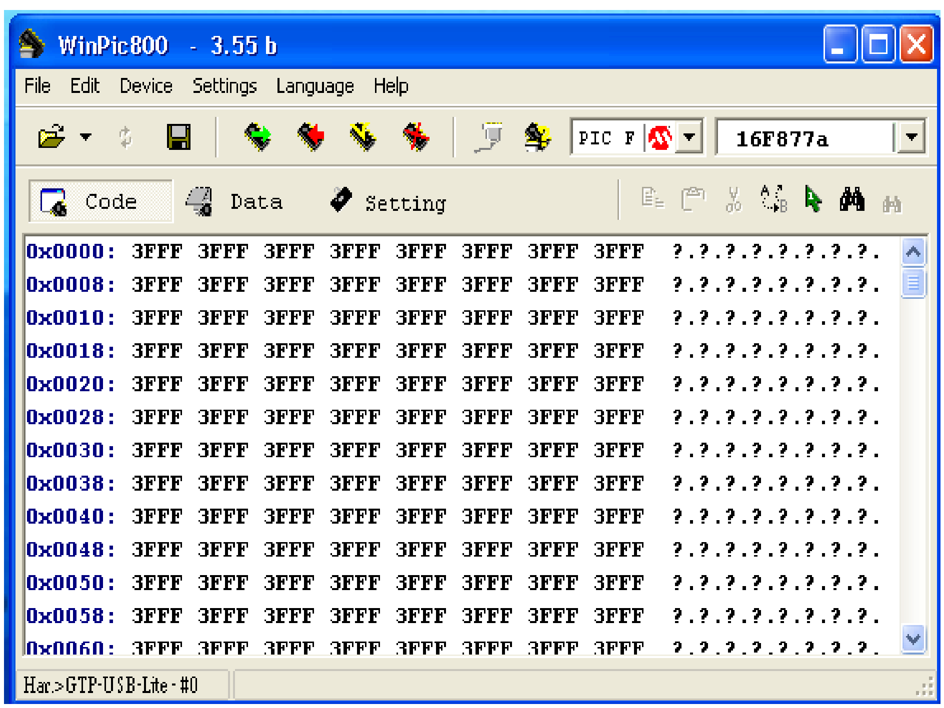


Figure 4.2.2.4 – Interface when data is loading when download data into PIC

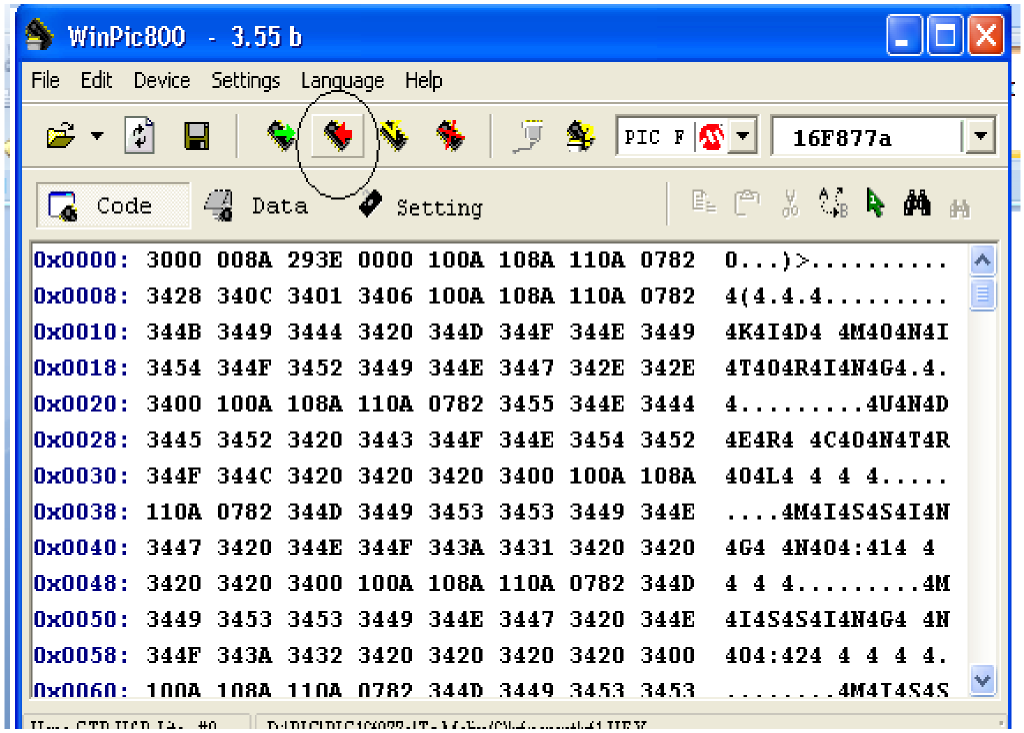


Figure 4.2.2.5 - Interface when data is loading when download data into PIC

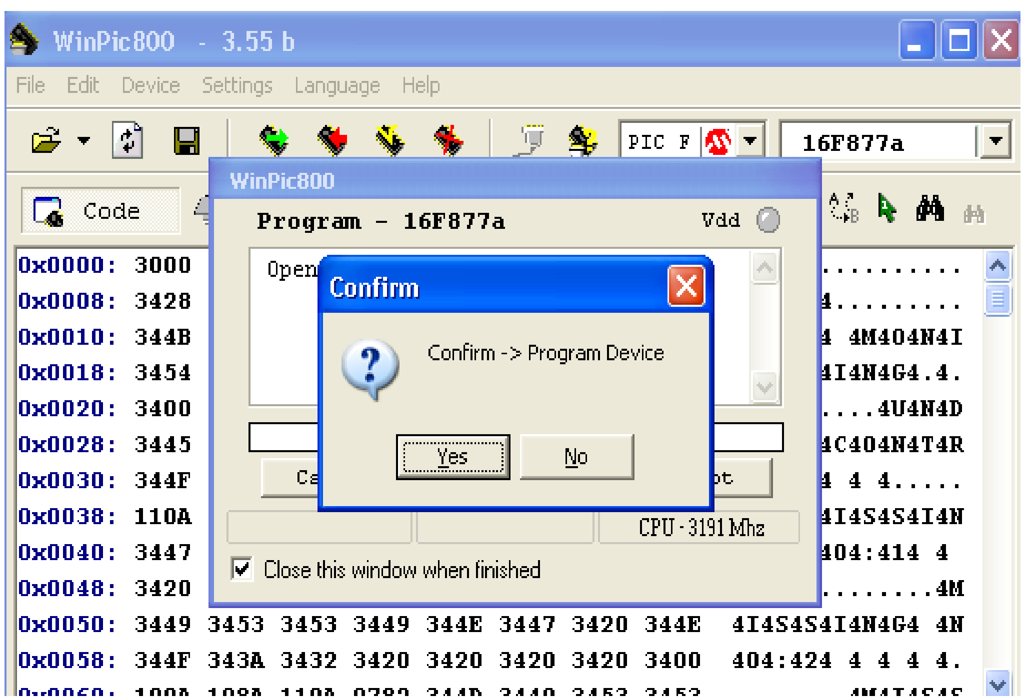


Figure 4.2.2.6 – Interface when finished data loading into PIC

4.2.2.1 Programming code used for PIC.

```
#include<16f877a.h>

#use delay (clock=20000000)

#fuses hs, noprotect,nowdt,nolvp

#define use_portb_lcd TRUE

#include <lcd.c>


#byte PORTd=8

#byte PORTc=7

#byte PORTb=6

void main ()

{

  lcd_init();

  lcd_putc("KID MONITORING..");


  set_tris_c(0b00000011);

  set_tris_d(0b00000000);

  set_tris_b(0b00000000);
```

```
    Do
   {
//////////////////////////input 1/////////////////////////////////////
              if(input(pin_c0)==0&&input(pin_c1)==0)
      {
        lcd_gotoxy(1,2);
        lcd_putc("UNDER CONTROL   ");

            output_low(pin_d0);
      }
      if(input(pin_c0)==0&&input(pin_c1)==1)
      {
        lcd_gotoxy(1,2);
        lcd_putc("MISSING NO:1    ");
        output_high(pin_d0);
      }
              if(input(pin_c0)==1&&input(pin_c1)==0)
  {
        lcd_gotoxy(1,2);
        lcd_putc("MISSING NO:2    ");
        output_HIGH(pin_d0);
      }
```

```
            if(input(pin_c0)==1&&input(pin_c1)==1)
      {
        lcd_gotoxy(1,2);
       lcd_putc("MISSING NO:1 & 2");
        output_HIGH(pin_d0);
      }
    }
  while(1);
}


      }
while(1);
}
```

Figure 4.2.2.7 – C Programming Code for this project

4.2.3 Transistor Drive Relay Circuit

Relay is a switch, the switch that operates from an electrical signal. Most of the relay using electromagnetic to change the switch or relay contact. There are two types of relay contact that is Normally Open (NO) and Normally Close (NC).

Relay used to control the application either high voltage circuit or low voltage circuit. Schematic circuit below used is to turn on or turn off the AC circuit AC (Alternating Current) from the low-voltage circuit through the microcontroller/PIC.

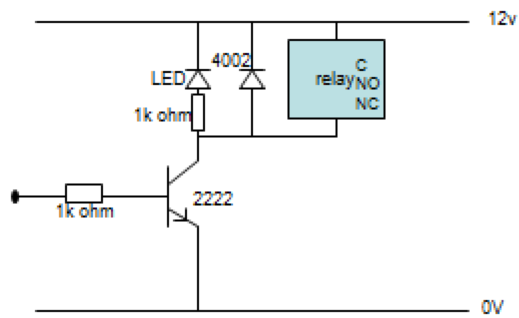


Figure 4.2.3.1 – Transistor Drive Relay Schematic

4.2.3.1 Transistor Drive Relay Circuit Components.

1. These are the component needed for transistor drive relay circuit.

Figure 4.2.3.2 – Transistor Drive Relay Component

From left : Relay 12 volt, Transistor NPN2222, Resistor Ik ohm, Pin Header, LED, Diode

4.1.1.2 Transistor drive relay circuit configuration steps.

1. Take the Transistor Drive Relay Circuit.

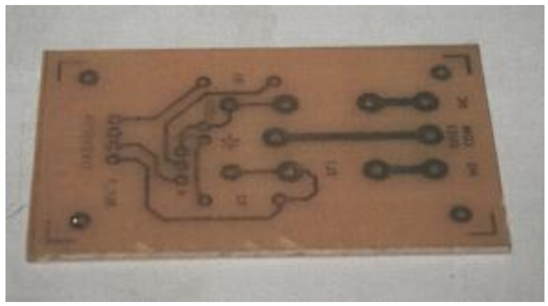


Figure 4.2.3.3

2. Insert two resistor 1k ohm.

Figure 4.2.3.4

Figure 4.2.3.5

3. Solder both resistors.

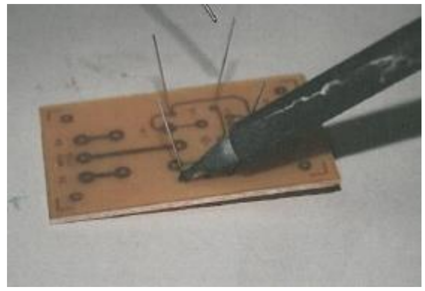


Figure 4.2.3.6

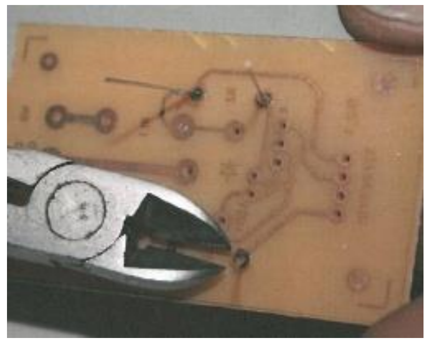


Figure 4.2.3.7

4. Resistor position is as shown below.

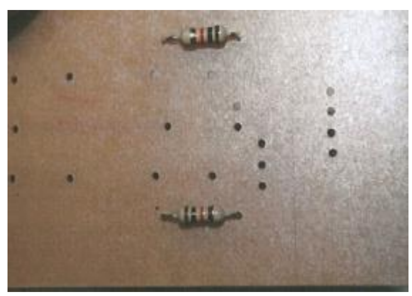


Figure 4.2.3.8

5. Insert the Diode

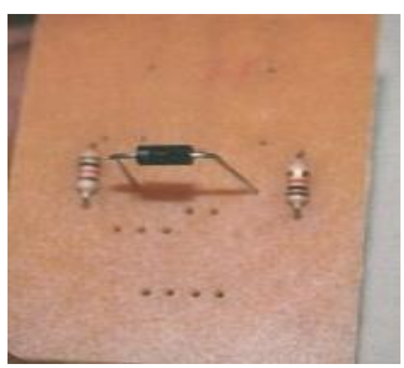


Figure 4.2.3.9

6. Solder that Diode.

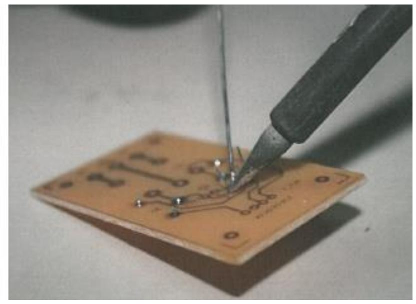


Figure 4.2.3.10

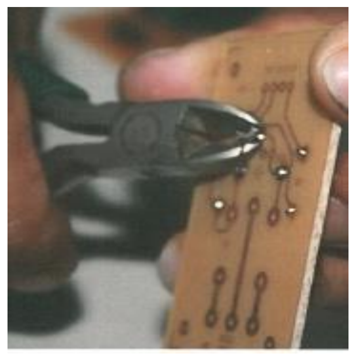


Figure 4.2.3.11

7. Insert the Relay 12volt.

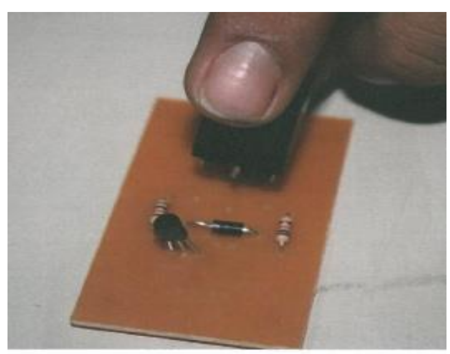


Figure 4.2.3.12

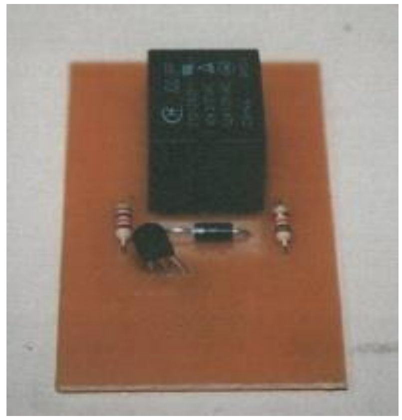


Figure 4.2.3.13

8. Solder that Relay.

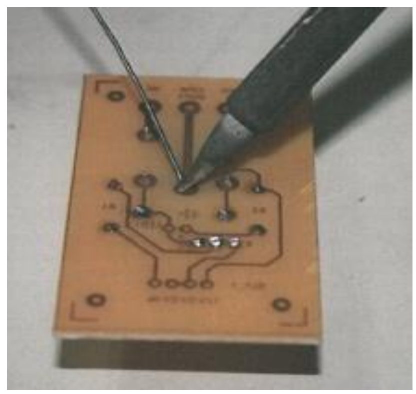


Figure 4.2.3.14

9. Insert the LED.

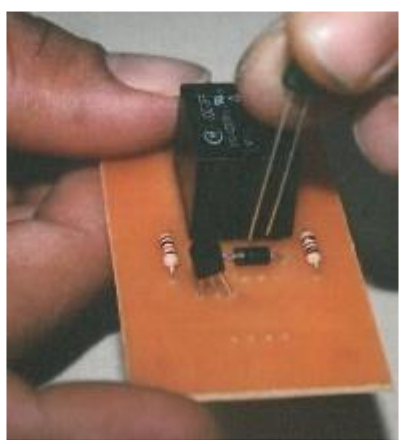


Figure 4.2.3.15

10. LED position is as shown below.

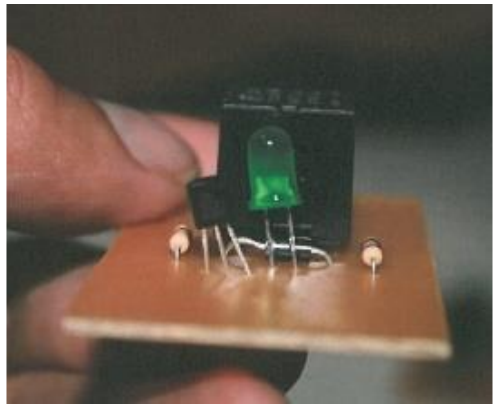


Figure 4.2.3.16

11. Solder that LED.

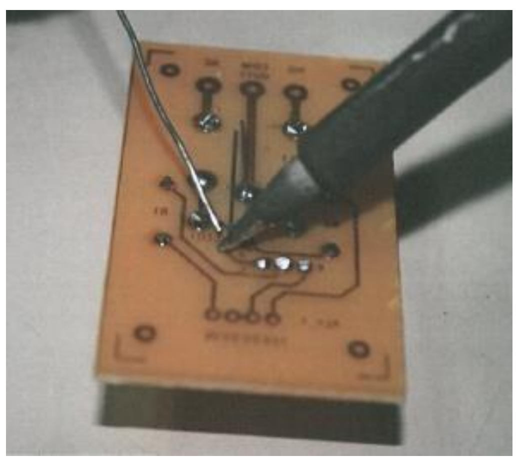


Figure 4.2.3.17

12. Transistor Drive Relay Circuit is as shown below.

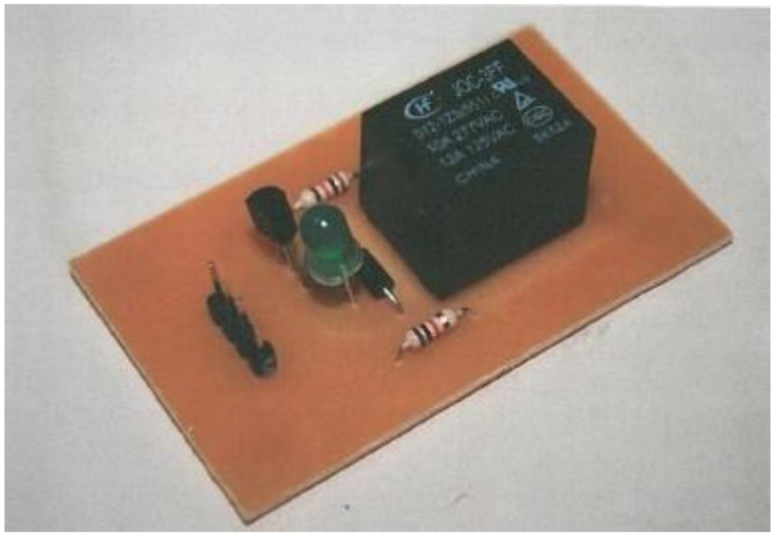


Figure 4.2.3.18

CHAPTER V

RESULTS, DISCUSSION AND CONCLUSION

This chapter briefly discusses the expected results of the CMS using RF technology project and following by discussion.

5.1 Results

Throughout this prototype device project, Children Monitoring System (CMS) which is developed to represent how the original idea proposed which is a pair of device that are designed for children and parents are able to detect each other when they are far from each other. For this project, the distance can reach until 2 meter (estimate trough project testing) if there is no blocking for RF frequencies. But, the distance will be shorten if there is lots of blocking signal such as wall or building. From the purpose project, this result can be associated to reduce the anxiety of the parents will lose their children while shopping at the mall. It also ensures security to prevent the disappearance of the child when in public places. It will help parents to protect their children more efficiently; parents will no longer feel pressure when they bring their children went for a walk in the public area by using this product. Besides that, parents can shopping safely while monitoring their children as well.

In addition, parents can shopping safely and take care of their children as well. With proper design and attractive, the children will be happy to wear the device, thereby avoiding the problem of discarded products everywhere by the child. It is generally known if the children do not like something, they will begin to ignore or discard. In addition this product should be established as it can also be an initial step to reduce the abduction cases, where parents can track their children more quickly.

The creation of this device also can be an additional services for security agencies that in charge of the focus areas for example in the carnival. Parents who want their children's safety be guaranteed, certainly willing to accept the services by the agency to facilitate them in handling or protecting their children.

5.2 Degree of Success

Degree of success of a certain project depends on the evaluator. As for this final year project, developer's supervisor and advisor play their role. The problems stated in earlier chapter have been solved and the most important criteria are that the expected objectives is managed to be meet. All the functionality is working properly and hoped to be user friendly as well. This system can even go higher level if there is no any constrain.

5.3 Limitations

It is a strong believes that every developed system has its own set of limitation. The same applies to this Children Monitoring system. Below are the limitations for the developed system.

- Distance, if there is lots of block/wall that block the RF signal.
- Confusion of signal if there is same device with same frequencies at same location.
- Limitation of power supply/battery if device is on/up for long period.

5.4 Future Enhancement

There is lots of element that can be enhance in future. Below are the elements that can be enhance.

- Using high frequency to enhance the signal.
- Using smaller size of circuit and component.
- Using better and component/devices.
- Using RFID technology
- Add more transmitter circuit to this project.
- Using antenna tuner to differ the frequency.

5.5 Discussion

This product can help parents with small children while he was in a focus area to monitor their children so as not to be away from them. This product is able to guarantee that their children will not be far away from their parents while their parents engrossed in shopping and so on. But this product cannot be guaranteed in the event of kidnapping cases, but this product is the first step to alert parents in dealing with kidnapping cases.

Among the obstacles that happen in this product is that the product is not able to detect exactly where the child is, because this product will trace the child through the sound, and not by coordinates, or the right position. Parents should be aware in using this tool, and not solely rely on these tools, but as a complementary tool rather than as a tool to rely on. Therefore, for the future, it will be more improved in terms of design, technology, and also the suitability over time. This is because all the weaknesses have been analyzed at that time and it will soon be improved to ensure that users are satisfied with this product.

5.6 Conclusion

In summary, introduction briefly describes and introduces the system. This system preliminary shows the basic concept of the system, problem statements of the system, objectives, scopes, and how the report is organized. Literature Review depicts the manual systems and the existing systems as the case studies of the project. This chapter also reviews the technique, method, equipment, and technology that had been used in the case studies. Methodology discusses about the overall workflow in the development of the project. This chapter also discusses the method, technique or approach that has been used while designing and implementing the project. While conclusion briefly summarizes the project.

This product is the first step to prevent the loss of a child by giving a signal to parents if their children are at a distance from them as an initial step to prevent the loss of children. According to a study that was done, these products have the strength to succeed in the market because there is no product that same with this product available in the market for this time at our country.

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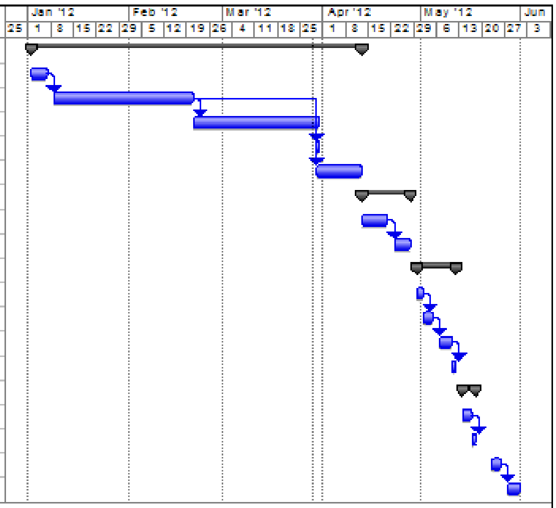
APPENDIX A

GANTT CHART

ID	Task Name	Duration	Start	Finish	Predecessors
1	**Development Stage**	**74 days**	**Mon 1/2/12**	**Thu 4/12/12**	
2	Define setting	5 days	Mon 1/2/12	Fri 1/6/12	
3	Digitalize interface design	31 days	Mon 1/9/12	Mon 2/20/12	2
4	Design model	29 days	Tue 2/21/12	Fri 3/30/12	3
5	Chapter 4 sbmission	1 day	Fri 3/30/12	Fri 3/30/12	3
6	Technique implementation	10 days	Fri 3/30/12	Thu 4/12/12	3
7	**Testing Stage**	**11 days**	**Fri 4/13/12**	**Fri 4/27/12**	
8	Usability testing	6 days	Fri 4/13/12	Fri 4/20/12	
9	Editing	5 days	Mon 4/23/12	Fri 4/27/12	8
10	**Discussion Stage**	**10 days**	**Mon 4/30/12**	**Fri 5/11/12**	
11	Result analysis	2 days	Mon 4/30/12	Tue 5/1/12	
12	Result discussion	3 days	Wed 5/2/12	Fri 5/4/12	11
13	Future research	4 days	Mon 5/7/12	Thu 5/10/12	12
14	Chapter 5 submission	1 day	Fri 5/11/12	Fri 5/11/12	13
15	**Maintenance Stage**	**4 days**	**Mon 5/14/12**	**Thu 5/17/12**	
16	System touch up	3 days	Mon 5/14/12	Wed 5/16/12	
17	Drafted thesis submission	1 day	Thu 5/17/12	Thu 5/17/12	16
18	**PSM 2 Presentation**	**3 days**	**Wed 5/23/12**	**Fri 5/25/12**	
19	**Final submission**	**4 days**	**Mon 5/28/12**	**Thu 5/31/12**	18



Project: gant psm2
Date: Thu 3/29/12

Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline

APPENDIX B

PLAGARISM CHECK (turnitin.com)