DEVELOPMENT OF BED THERAPY FOR COMATOSE

RAIHANAH AMIRAH BINTI RAMLY

POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

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**THESIS SUBMITTED IN PARTIAL FULFILMENT FOR THE DEGREE OF
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DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged.

Signature : ....

Name : RAIHANAH AMIRAH BINTI RAMLY

Registration No. : 08BEU16F3024

Date : 05 JULY 2018

ENDORSEMENT

I hereby acknowledge that I have read this report and I find that its contents meet the
requirement in term of scope and quality for the award of the Bachelor of Eletronic
Engineering Technology (Medical Electronic) With Honours

Signature   : ....
Name   : ....
Date   : ....

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Not to forget to the Dr Masliha Binti Harun, Doctor who is willingly to help me by giving an advice and recommendation about my project. Lastly, I would like to thank all those supported me in any aspect during the completion of the project.

ABSTRACT

Bed therapy was developed for comatose patient or the patient who was in intensive care unit (ICU), for embrace patient who having the sore or can we called as decubitus ulcer behind the body's patient. This decubitus ulcer can occur when the patient does not have enough ventilation mechanical. Ventilation mechanical issues are very important for a bedridden patient. This bed are used to relief the pressure for prevent any sore for patient or comatose. This bed will be rotate 360 degree by using asynchronous motor to rotate the bed automatically for a certain time depending on the patient's need. For that time, comatose will stay upside down to relief the pressure and also reduce soreness before bed therapy going back to its normal state. This bed therapy is also capable of accommodating the weight of patient up to 120 kg to be reversed as a therapy to reduce pain and giving the enough ventilation mechanical. There also has the programming to setup the time for being upside down depend on the patient's need and for sure there is precaution to handle to prevent others accidents. This study applied a quantitative method with a survey distributed to 50 degree students of medical electronic from Politeknik Sultan Salahuddin Abdul Aziz Shah. For the technical result shown that this device was comfortable, suitable and able to relief the pressure of bedridden and able to avoid the bedsore happen.

ABSTRAK

Katil terapi diolah untuk pesakit koma ataupun untuk pesakit yang berada di bilik unit rawatan rapi untuk pesakit yang menghadapi sakit atau boleh dikenalpasti sebagai ulcer pada bahagian belakang badan pesakit.ulcer ini terhasil apabila pesakit tidak mendapat pengudaraan mekanikal yang cukup. Pengudaraan mekankal ini sangat penting bagi pesakit yang terlantar. Katil ini digunakan untuk mengurangkan tekanan bagi mengelakkan lebam pada pesakit atau besakit koma. Katil ini akan berputar 360 degree dengan menggunakan motor 1 fasa untuk memusingkan katil secara automatik dalam masa-masa tertentu bergantung kepada keperluan pesakit. Pesakit koma akan berbaring secara terbalik bagi mengurangkan tekanan dan untuk mengurangkan lebam sebelum katil terapi kempali kepada keadaan asal . Katil ini juga mampu untuk menampung berat pesakit sehingga Terdapat juga pengaturcaraan untuk menetapkan masa untuk menjadi terbalik bergantung kepada keperluan pesakit dan pasti ada langkah berjaga-jaga untuk menangani untuk mencegah kecelakaan yang lain. Kajian ini menggunakan kaedah kuantitatif dengan satu kaji selidik yang diedarkan kepada 50 darjah pelajar elektronik perubatan dari Politeknik Sultan Salahuddin Abdul Aziz Shah. Untuk hasil teknikal yang ditunjukkan bahawa peranti ini selesa, sesuai dan dapat melegakan tekanan di atas katil dan boleh mengelakkan kerosakan yang berlaku.

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INTRODUCTION

1.1   BACKGROUND OF STUDY

Coma was defined as a state very unconsciousness which the patient cannot be roused by ordinary treatment. It also known as a deep sleep, but coma is not actually a sleep at all, but the state the unconsciousness usually caused by the injury or an illness. In general, unlike patients who experience even very deep sleep such as in narcolepsy (sudden uncontrollable sleep attacks and cataplexy, often accompanied by visual or auditory hallucinations at the onset of sleep). The comatose patient display no spontaneous eye movement, nor response to painful stimulus (in deep stage of coma), nor ability to talk. There are however, degree of conscious impairment in patients which may not rise the level of coma, as measured by Glasgow coma scale.

Table 1.1 : Glasgow coma scale

(Source: John Furst , 19 2013)

TABLE 38-2
Glasgow Coma Scale

BEHAVIOR	RESPONSE	SCORE
Eye opening response	Spontaneously	4
	To speech	3
	To pain	2
	No response	1
Best verbal response	Oriented to time, place, and person	5
	Confused	4
	Inappropriate words	3
	Incomprehensible sounds	2
	No response	1
Best motor response	Obeys commands	6
	Moves to localized pain	5
	Flexion withdrawal from pain	4
	Abnormal flexion (decorticate)	3
	Abnormal extension (decerebrate)	2
	No response	1
Total score:	*Best response*	15
	Comatose client	8 or less
	Totally unresponsive	3

The Glasgow Coma Scale commonly shorten to GCS is a measurement of a patient level of consciousness, ie how awake the patientUnder that scale, in which best motor response, best verbal response, and minimum stimulus to cause eyes opening are tested and score, the scored may range from 3 to 15. A score of 3 indicates no motor response (regardless of cause), no vocalization even in response to noxious stimulus and no eye opening in response to noxious stimuli. Score of 7 or less on the Glasgow scale quality as coma [1].

Bed therapy also was created for comatose patient or the patient who was in intensive care unit (ICU) frequently exhibit pulmonary function worsening, especially in cases of pulmonary infection. One investigation of geriatric nursing problems in hospital on 1959 until 1960 shown that the sore cases in elderly patients is high and it increase with age [2].They are particularly at risk because they are relatively immobile [3]. Prolonged pressure, shearing forces, friction and moisture are all etiological factors

[4].They usually formed over bone prominences, such as the base of spine, hips and heels [5]

Prevention depend on excellent nursing care that concentrates on meticulous skin care and relief of pressure. The position of patient are the most important to prevent of pressure ulcers [6]. This bed are used to relief the pressure for prevent any sore for comatose. This bed will be rotating 180 degree by using some special electronic device design to auto rotate the bed which is 30 minute upside down. For 30 minutes, comatose will stay upside down to relief the pressure and also reduce soreness. For sure, there is other precaution to prevent any accidents.

Besides the comatose patient, the normal people also can use this bed as a normal bed by locking the bed from rotate, than the bed can be function as a normal bed. Before this bed therapy was developed, there is survey by discussion with the staff at PPUM, there is some problem statement that have been found and need the improvement to curing this disease. This idea was told by the PPUM staff that is to rotate the bed, so that they can reduce the pressure of comatose.

1.2   PROBLEM STATEMENT

From the staff of Universiti Malaya Medical Centre UMMC or Pusat Perubatan Universiti Malaya (PPUM) by collecting data through interviewing the medical staff, beside doing research, there are some problem that concern and giving the idea for develop a bed therapy for comatose who having a prolonged pressure and having the implication which is sore happened to the patient's body that cause a decubitus ulcer behind body's pation at certain area.

For a comatose, there is no certainty when the patient will be awake. There is no possibility for comatose to be exposed after 1 week, 1 month, 1 year, 5 years,

10 years or maybe more. After the studying the therapy bed, some problems of bed therapy is identified. First, the comatose who does not have enough ventilation while they laying down on bed for a long time will have prolonged pressure and will be in sore. This will make the condition of comatose will be worst, because the sore will be deeper if we cannot reduce the pressure.

Rather than that medical problem, before develop of this bed therapy, there rotate the bed manually and needed a few of medical staff to rotter the bed. Because they need to make sure the patient having the enough care while handle that manual bed therapy. Because of it, a patient must have more than one of medical staff to in charge.

Last but not least, there is no electronic device that design to make the bed rotate in automatically with the certain time. So that the medical staff has to focus on the patient and be alert so the patient can laying to the supine position on time.

1.3   OBJECTIVE

The main objective of this project is:

(i)   To design a bed therapy that can be helped the comatose to get their mechanical ventilation.

(ii)   To develop a bed therapy that can reduce the energy of medical staff from manually spin the rotter to rotate the bed.

(iii)   To analysis the rotary bed that can be set the certain time for comatose for upside down.

1.4   SIGNIFICANT OF STUDY

This study is to develop the bed therapy for the comatose that having the bed sore problem. It also to help patients to prevent the soreness that causes of prolonged pressure by laying too long in bed while unconscious period. For the patients that have not got the enough ventilation and this bed therapy was able to use at home or at Intensive Care Unit (ICU) but, the using at ICU are priority.
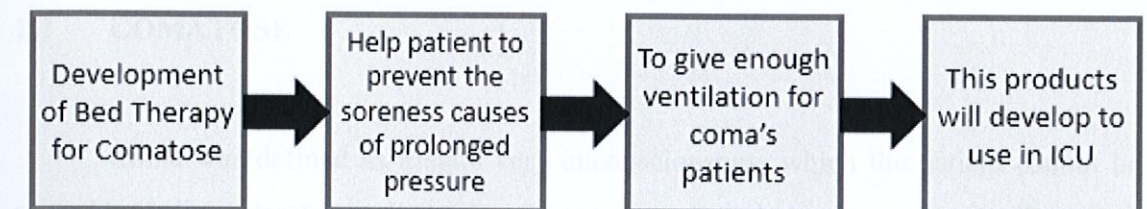
Block Diagram 1.1 : Significant of study

1.5   THEORETICAL OF STUDY
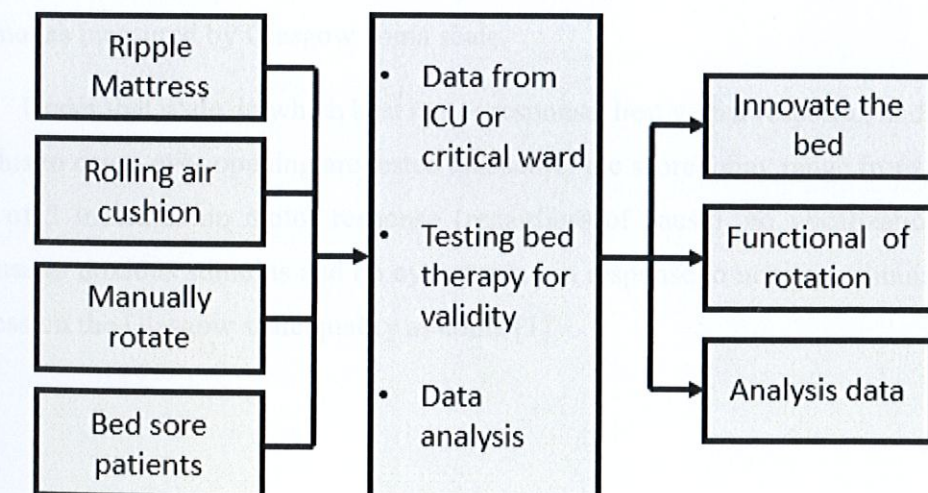
Block Diagram 1.2 : Theoretical of study

CHAPTER 2

LITERATURE REVIEW

2.1 COMATOSE

Coma was defined as a state very unconsciousness which the patient cannot be roused by ordinary treatment. It also known as a deep sleep, but coma is not actually a sleep at all, but the state the unconsciousness usually caused by the injury or an illness. In general, unlike patients who experience even very deep sleep such as in narcolepsy (sudden uncontrollable sleep attacks and cataplexy, often accompanied by visual or auditory hallucinations at the onset of sleep). The comatose patient display no spontaneous eye movement, nor response to painful stimulus (in deep stage of coma), nor ability to talk. There are however, degree of conscious impairment in patients which may not rise the level of coma, as measured by Glasgow coma scale.

Under that scale, in which best motor response, best verbal response, and minimum stimulus to cause eyes opening are tested and score, the scored may range from 3 to 15. A score of 3 indicates no motor response (regardless of cause), no vocalization even in response to noxious stimulus and no eye opening in response to noxious stimuli. Score of 7 or less on the Glasgow scale quality as coma [1]
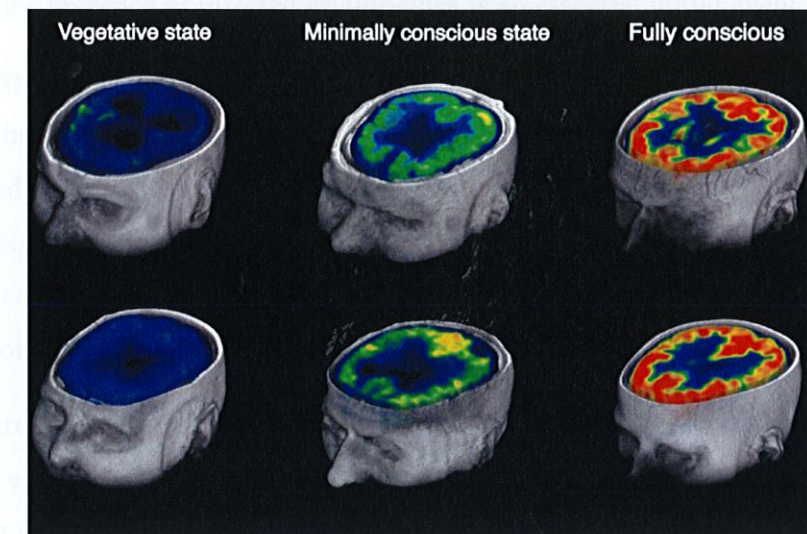
Figure 2.1 : Comatose Patient Brain

2.1.1 Cause of coma

Cerebral malaria is one of the major manifestation of severe malaria and is defined as an acute encephalopathy, arising from Plasmodium falciparum infection, accompanied by variable neurological sign (the essential one of which is coma), in an individual in whom other causes of of coma can confidently be excluded [7]. As one of the common causes of death in malaria, and probably the commonest cause of coma in the world, it is extraordinary that so little is understood of its pathophysiology.

Although numerous clinical studies and pathological descriptions have been published, it is only relatively recently that rigorous clinical definitions have been combined with experimental and quantitative pathological approaches.

2.1.2 Cerebral Malaria

Integrating these observations, we believe that cerebral malaria results from an interaction between host and parasite in which upregulated levels of adhesion receptors in

the brain direct the sequestration of infected cells to that site. In this 'sequestration' hypothesis the presence of infected erythrocytes is an essential initial event.

Downstream effector mechanisms may include the effects of sequestration on tissue perfusion, the localized release of metabolically active substances (such as lactic acid) and the local induction of cytokines and agents with neurotransmitter or vasomotor activity [such as TNF or nitric oxide (NO)]. Clark and Rockett (this issue) now put forward an alternative concept by postulating that these agents (TNF and NO) are the sole etiological factors in coma and that their local elaboration is independent of the presence of parasites.

There is a strong body of evidence linking the presence of large numbers of parasitized erythrocytes in the cerebral microcirculation with cerebral malaria. A simple observation is that P. fulciparum sequesters in many sites including the brain and causes cerebral malaria, whereas other species (such as P. vivux) apparently do neither [8]. Although it has been claimed that P. vivux can cause cerebral malaria, the extraordinary rarity of such cases, the frequent presence of mixed infection and the difficulties in excluding other causes of encephalopathy make this clinical syndrome unlikely, bearing in mind the common occurrence of P. nivux malaria.

2.2   PRESSURE

The pressure caused when body weight is transmitted to an under laying surface, such as mattress, through bony prominences interferes with circulation in the intervening tissue. This pressure on the fat, muscle and skin causes discomfort progressing to pain which normally in health, invites change of posture. If the position is not changed, ischaemia is produced and pressure sores result. The degree and extend of the effect of local pressure depends not only on it intensity and duration, but also on its direction. Thus a shearing stress cuts off a larger area from its vascular supply than does vertical pressure.

Pressure ulcer commonly happened in certain area, where is soft tissue injury resulting from compression between bone prominence. There is similar on use of the pressure term ulcer that is synonyms which is decubitus ulcer or bed sore. The most

common place for decubitus ulcer was hips, buttocks, back and ankle. This condition is common among the people who spend long periods in bed or a wheelchair, for disable people and the people who cannot move the certain body parts without supporter.

Gutmann distinguishes various stages in the development of a pressure sore in patients with paraplegia.

1) Stage of Transient Circulatory Disturbance
2) Stage of Definite, Superfical Circulatory and Tissue Damage

Normal capillary pressure varies between 12 and 32 mm Hg. The human body can withstand extremely high pressure when equally distributed over the body, which is demonstrated by the deep sea divers who regularly withstand pressure of 1000 mm Hg without injury [3]. When external pressure are applied to a localized area of the body such as a bony prominence, however, interstitial pressure increases. Once this has exceeded the capillary venous limb pressure of 12 mm Hg, a marked increase in total pressure is produced. This result in increased capillary arteriolar pressure, capillary leakage, edema and eventually autolysis [4].
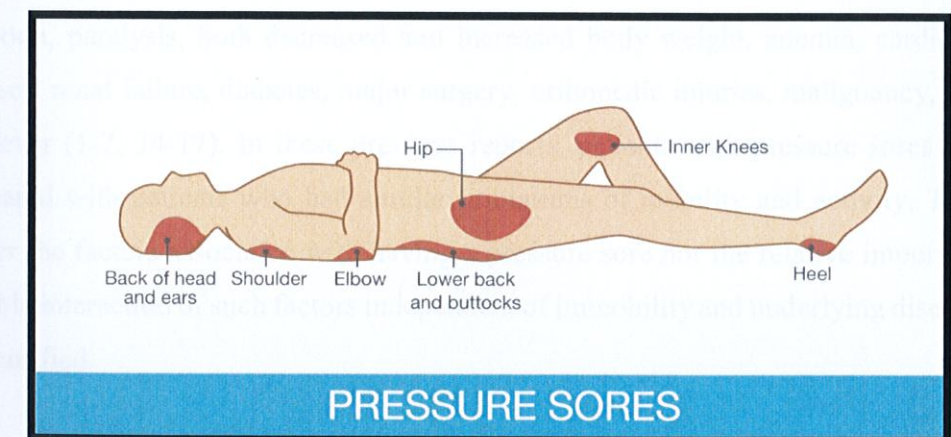

Figure 2.2 : Pressure Ulcer commonly area

2.2.1 Pressure Sore

The epidemiology of pressure sores among hospitalized patients in the United States is currently poorly defined, but the data available suggest that pressure sores are a serious

problem. Studies from Europe, South Africa, and Canada have found that 3% to 11% of hospitalized patients have pressure sores (1-6) and that 1% to 3% will develop sores [9] [10]About a fourfold increased risk of death has been reported with the development of a pressure sore among geriatric patients and those in nursing homes [2] [11], and failure of a sore to heal has been associated with nearly a six times higher rate of death [9] Complications of pressure sores include osteomyelitis and sepsis (11-13), and the mortality rate of sepsis approaches 50% [12] [13] [14].

Despite the potential seriousness of the problem for hospitalized patients, factors that would identify bedridden patients at greatest risk for pressure sores have not been well defined. The incidence of pressure sores is highest among the elderly [15] [16]. Norton and colleagues [2] have developed a scoring system to identify patients at risk that includes an assessment of general physical condition, mental status, activity level, mobility, and continence. In a group of 59 orthopedic patients over 60 years of age, the score identified 12 of 13 patients who developed a pressure sore, but 20 of 32 patients defined as at risk did not develop a sore [17].

Other factors that may place patients at higher risk include malnutrition, volume depletion, paralysis, both decreased and increased body weight, anemia, cardiovascular diseases, renal failure, diabetes, major surgery, orthopedic injuries, malignancy, sedation, and fever (1-7, 14-17). In these previous reports, patients with pressure sores were not compared with patients who had similar limitations of mobility and activity. Therefore, neither the factors associated with having a pressure sore nor the relative importance and possible interaction of such factors independent of immobility and underlying disease could be identified.

To define factors associated with the presence of a pressure sore among adult hospitalized patients, we studied patients with pressure sores and a group of patients at risk, who had been or were expected to be confined to a bed or chair for at least 1 week. This study allowed us to identify factors that may help target preventive measures for patients at greatest risk. In addition, we measured the magnitude of the length of stay and hospital charges for patients with pressure sores and showed that pressure sores may increase the risk of in-hospital death.

Table 2.1 : Criteria used to identify patients at risk of developing pressure sores together with classification of skin changes in at risk group during 10-day observation period. (evidence of pressure sore)

Risk criteria		Registered skin changes
Absolute (score 2)	Relative (score 1)	
Unconsciousness	Age (⩾ 70 years)	Normal skin
Dehydration	Restricted mobility	Redness and infiltration
Paralysis	Incontinence	Extravasation
	Pronounced emaciation	Bullae*
	Redness over bony prominences	Black necrosis*
		Skin defect*

2.3   RIPPLE MTTRESS

Pressure sores are one of the difficult problems to handle in geriatric patients and it commonly happened to those who are had a prolonged pressure by laying or by sitting in the wheelchair. Miki Hospital, Maesawa _Machi and Department of Geriatric Medicine was told that the effect of rolling bed on Decubitus in Bedridden Nursing Home Patients witch turns the patients to a 15 degrees inclined lateral positions with an inflating ripple mattress and the result was no totally successful, and the size that had been measured with before are no significant difference [18].

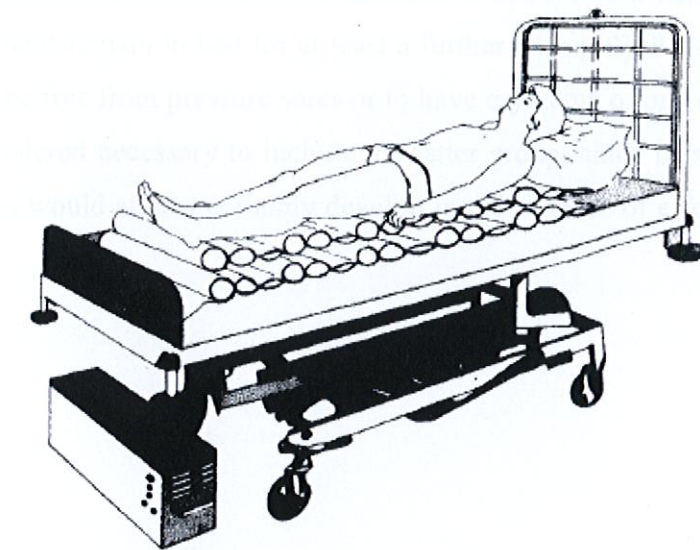Figure 2.3 : Ripple Mattress

2.3.1 Air Wave System

Figure 2.4 : Diagrammatic representation of the AWS.

The operation of the AWS is similar to that of the LCM, but it has two layers of air cells rather than one. The cells are kept in register by polystyrene-like molds along each

side. Pressure is alternated by deflating every third cell in turn, each cycle taking 71/2 minutes (see accompanying figure). To help ease the problems caused by the patient lying on skin soaked with sweat or urine the mattress is ventilated with numerous pinholes through which a continuous flow of air passes. The air is dispersed by means of a washable wool fleece which is placed on top of the mattress. No plastic draw sheets are used, since they hinder the flow of air through the pinholes.

Patients eligible for entry to the trial were those newly admitted to the geriatric wards of the University College Hospital (UCH group), patients with fracture of the femoral neck in orthopedic wards immediately after their operations (UCH), and long-stay patients in the Royal Hospital and Home for Incurables (RHHI). Previous studies have shown that evaluation of the effectiveness of prophylactic procedures is best achieved by selecting, as we did, only those patients who are at highest risk-i.e., those with a score of 14 or less on the clinical scoring system' (see table below.

For the long stay patients in RHHI additional criteria were a fall in clinical score of at least 10% below the usual score or confinement to bed for 48 h with the expectation that the patient would remain in bed for at least a further 24 h [19]. Patients entering the trial had either to be free from pressure sores or to have erythema of one or more pressure areas. It was considered necessary to include the latter group, since these patients are at high risk and sores would almost certainly develop in the absence of effective preventive measures.

Table 2.2 : Clinical Scoring System (Norton Scale)

Score	General physical condition	Mental state	Activity	Mobility	Incontinence
4	Good	Alert	Ambulant	Full	Not
3	Fair	Apathetic	Walks with help	Slightly limited	Occasionally
2	Poor	Confused	Chairbound	Very limited	Usually (urine)
1	Very bad	Stuporose	Bed	Immobile	Doubly

Maximum score = 20.

2.4 OTHER CONTRIBUTING ETIOLOGICAL FACTORS

Any condition that interferes with the metabolism of normal cells has the potential to alter the response to a mechanical insult such as pressure. Most patients in intensive care units have multisystem disease and altered metabolism, and cardiovascular compromise in these patients may lead to poor oxygen perfusion of the cutaneous capillary beds. Anemia, blood dyscrasias, and vascular fragility contribute to diminished oxygen availability. Interstitial edema decrease the cutaneous blood supply by increasing capillary pressure and increasing the distance blood must travel to reach skin. Nutrition may also alter the body's response to pressure [20].

2.5 PROTOCOL

Patients were randomized into two group, the prone position (PP) group, patient recruited in this group were positioned prone for 4 hour daily. The first period in the PP had to begin within 24 hour after intubation. Prone positioning was strictly horizontal, head out of bed, with respect to the head-neck-trunk axis to avoid any obstacle to cerebral venous return. Ventilatory settings remained unchanged during PP. The criteria to finish daily

periods in PP was the ability of the patient to get up to sit in an armchair [21]. When the patient is in prone position, there is significant pressure placed on the forehead, cheeks, and chin, which may result in pressure ulcer formed [22].

2.6. ARDUINO UNO

Figure 2.5 : Arduino UNO

Figure 2.4 shows arduino UNO. Arduino UNO is a microcontroller board based on the Atmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), ^ analog inputs, a 16MHz quartz crystal, a USB connection port, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Others can tinker with UNO without worrying too much about doing something wrong, wrost case scenario the chip need to be replace for a few dollars and start over again. "UNO" means one in Italian and was chosen to mark the release of Arduino software (IDE) 1.0. The UNO board and version of Arduino now evolved to newer releases. The UNO board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform for an extensive list of current, past or outdated boards see the Arduino index of boards.

2.7   ATMEGA 328/P AU

The ATMEGA328P-AU is a high-performance 8-bit AVR RISC-based Microcontroller combines 32kb ISP flash memory with read-while-write capabilities, 1kb EEPROM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8 channels in TQFP

Table 2.3 : ATmega328 information

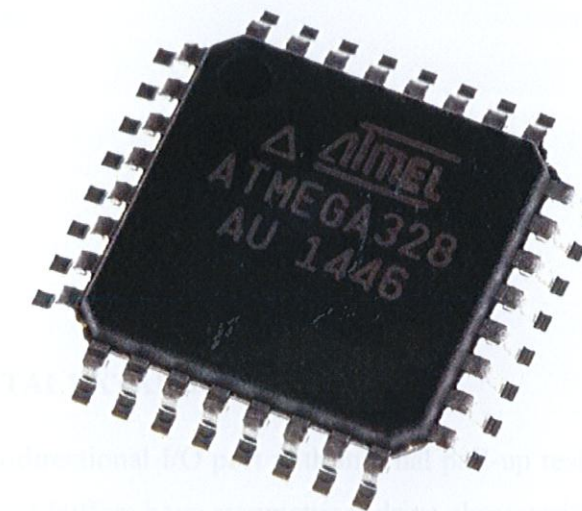| Speed [MHz][3]	Power Supply [V]	Ordering Code[2]	Package[1]	Operational Range
20	1.8 - 5.5	ATmega328P-AU ATmega328P-AUR[5] ATmega328P-MMH[4] ATmega328P-MMHR[4][5] ATmega328P-MU ATmega328P-MUR[5] ATmega328P-PU	32A 32A 28M1 28M1 32M1-A 32M1-A 28P3	Industrial (-40°C to 85°C)
		ATmega328P-AN ATmega328P-ANR[5] ATmega328P-MN ATmega328P-MNR[5] ATmega328P-PN	32A 32A 32M1-A 32M1-A 28P3	Industrial (-40°C to 105°C)

Figure2.6 : Figure of ATmega328/P-au
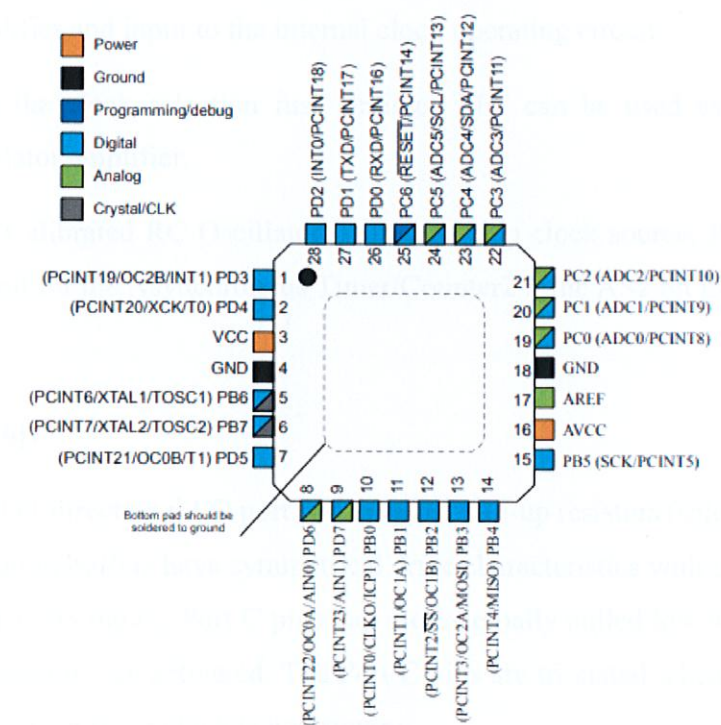
2.7.1 Pin description and configuration

Figure 2.7 : Pin desicription and configuraton

VCC

Digital supply voltage

GND

Ground

Port B (PB[7:0]) XTAL1/XTAL2/TOSC1/TOSC2

Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Depending on the clock selection fuse settings, PB6 can be used as input to the inverting Oscillator amplifier and input to the internal clock operating circuit.

Depending on the clock selection fuse settings, PB7 can be used as output from the inverting Oscillator amplifier.

If the Internal Calibrated RC Oscillator is used as chip clock source, PB[7:6] is used as TOSC[2:1] input for the Asynchronous Timer/Counter2 if the AS2 bit in ASSR is set.

Port C (PC[5:0])

Port C is a 7-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The PC[5:0] output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running.

PC6/RESET

If the RSTDISBL Fuse is programmed, PC6 is used as an I/O pin. Note that the electrical characteristics of PC6 differ from those of the other pins of Port C.

If the RSTDISBL Fuse is unprogrammed, PC6 is used as a Reset input. A low level on this pin for longer than the minimum pulse length will generate a Reset, even if the clock is not running. Shorter pulses are not guaranteed to generate a Reset.

The various special features of Port C are elaborated in the Alternate Functions of Port C section. C6/RESET

Port D (PD[7:0])

Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.

AVCC

AVCC is the supply voltage pin for the A/D Converter, PC[3:0], and PE[3:2]. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter. Note that PC[6:4] use digital supply voltage, VCC.

AREF

AREF is the analog reference pin for the A/D Converter

ADC[7:6] (TQFP and VFQFN Package Only)

In the TQFP and VFQFN package, ADC[7:6] serve as analog inputs to the A/D converter. These pins are powered from the analog supply and serve as 10-bit ADC channels.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

For completing this project, there are several task need to be done. The task that can be divided in three phase which are research phase, device development phase and last one is testing and data analysis phase. The first phase is actually the most important phase, it is because on this first phase almost all of the knowledge that needed for this project are collected from this phase. The second phase begin after all of the info and data was enough collected. Second phase is the whole process of development of the device. Starting from programming, circuit design, and device design until the product is finish and can be test. Third phase, which is last phase important for the result of the product. On this phase, the product will be tested until the objective of the project are achieved.

This section will go through about the research of methodology and will tell more specific about the method that used to proceed this study. There is two type of methodology that used in this study which is method research framework involve both quantitative and qualitative methods and measures. In this section also will explain about the design and assemble of the product as well as describing the measure which used to provide informational perspectives to gaining more understanding. This part of methodology are most important part in this study because its play an important role in implementing this study. All of details about methodology are well explained in this section. Figure below shoe the flowchart of the project.

Start

Collecting Data to find problem statement

Design

Programming and making hardware

Testing

Failed

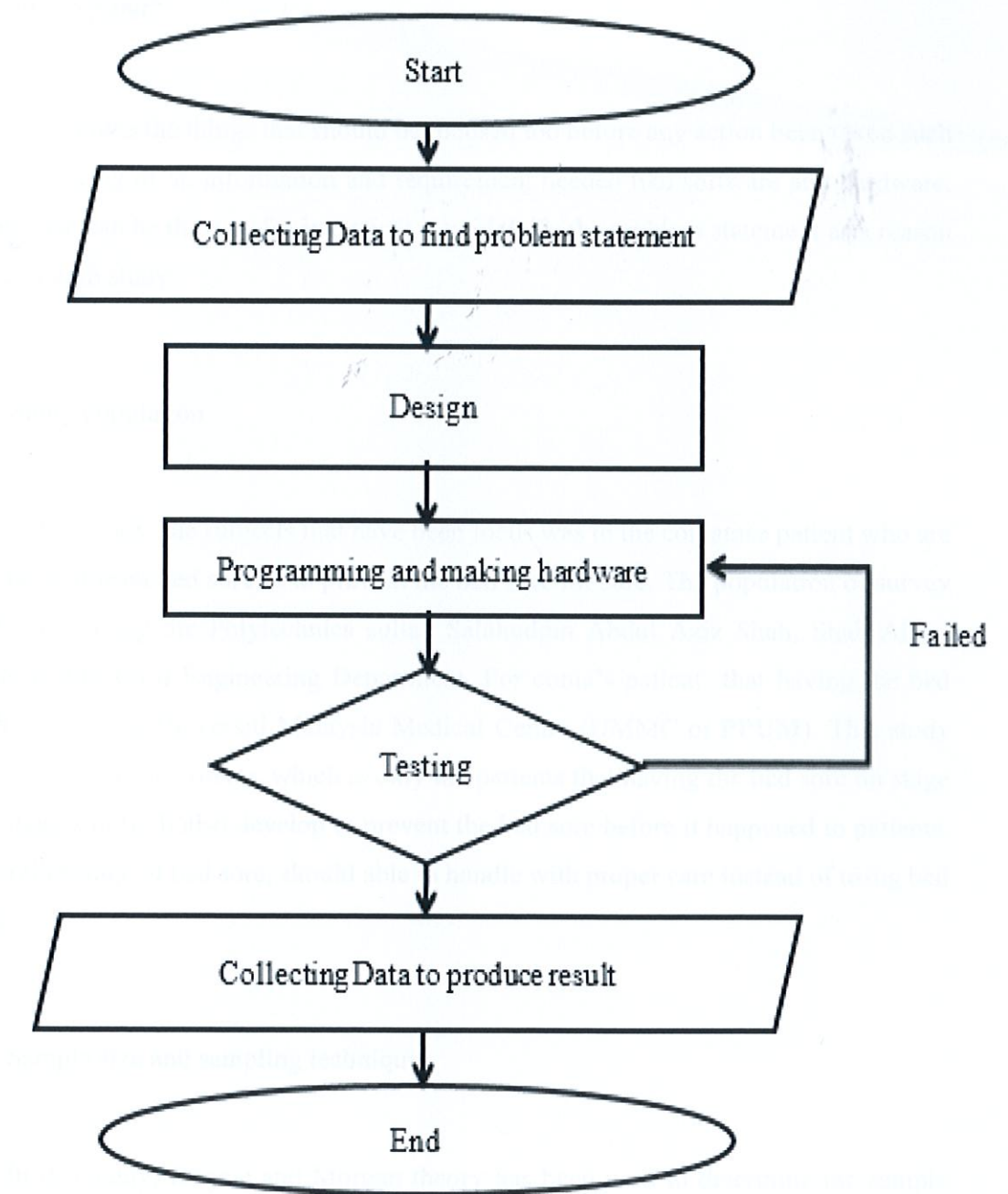Collecting Data to produce result

End

Figure 3.1 : Flow chart of the project

3.2   PLANNING

Planning is the things that should be focused too before any action been taken such as the identifying of an information and requirement needed like software and hardware. Planning also can be the way for investigator to identify the problem statement as a reason to proceed with study.

3.2.1   Study population

In this study, the subjects that have been focus was to the comatose patient who are should be heal from bed sore or to prevent the bed sore for sure. The population of survey subjects are among the Polytechnics sultan Salahuddin Abdul Aziz Shah, Shah Alam, focusing in Electrical Engineering Department. For coma's patient that having the bed sore, they are from Universiti Malaysia Medical Centre (UMMC or **PPUM**). This study has its own exclusion criteria, which is only the patients that having the bed sore on stage 1 until stage 2 only. It also develop to prevent the bed sore before it happened to patients. For the other stage of bed sore, should able to handle with proper care instead of using bed therapy.

3.2.2   Sample size and sampling technique

In this study, Krejcie and Morgan theory has been used to determine the sample size. The population of this study is 50 subjects, so by referring to this Krejcie and Morgan theory, the sample size will be 44 subjects.

Table 3.1 : Krejcie and Morgan table

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	1000000	384

Note: N is Population Size; S is Sample Size   *Source: Krejcie & Morgan, 1970*

3.3 COMPONENT LIST

These are component used in this project;

- Arduino UNO
- ATmega32/P-au
- Single Bed
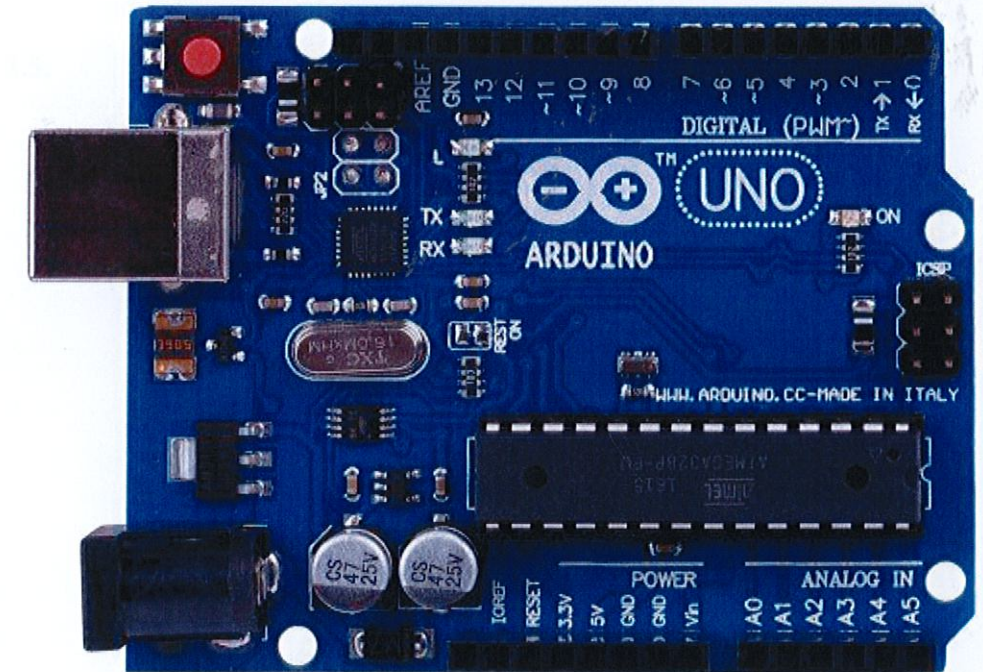- Asynchronous Motor
- Ratchet Belt

Figure 3.2 : Arduino UNO

Figure shows arduino UNO. Arduino UNO is a microcontroller board based on the Atmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), ^ analog inputs, a 16MHz quartz crystal, a USB connection port, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. Others can tinker with UNO without worrying too much about doing something wrong, wrost case scenario the chip need to be replace for a few dollars and start over again. "UNO" means one in Italian and was chosen to mark the release of Arduino software (IDE) 1.0.

The UNO board and version of Arduino now evolved to newer releases. The UNO board is the first in a series of USB Arduino boards, and the reference model for the Arduino

platform for an extensive list of current, past or outdated boards see the Arduino index of boards.
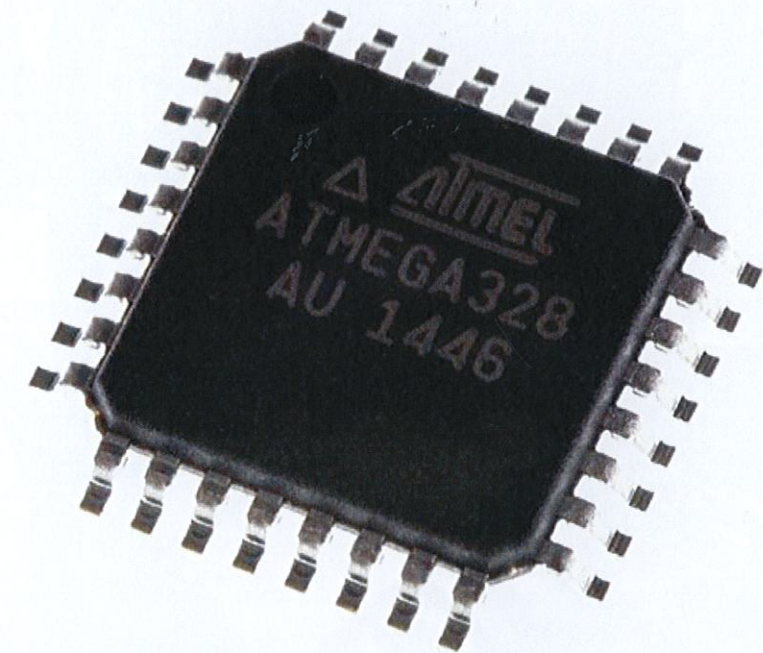
3.5.   ATMEGA328/P-AU

Figure 3.3 : ATmega328/P-au

The ATMEGA328-AU is a high-performance 8-bit AVR RISC-based Microcontroller combines 32kb ISP flash memory with read-while-write capabilities, 1kb EEPROM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8 channels in TQFP).

3.6.   SINGLE BED

Figure 3.4: Single Bed

Figure 3.4 shows the single bed that is recycled from the dormitory , this bed was renovate into the design that had been designed for bed therapy before.
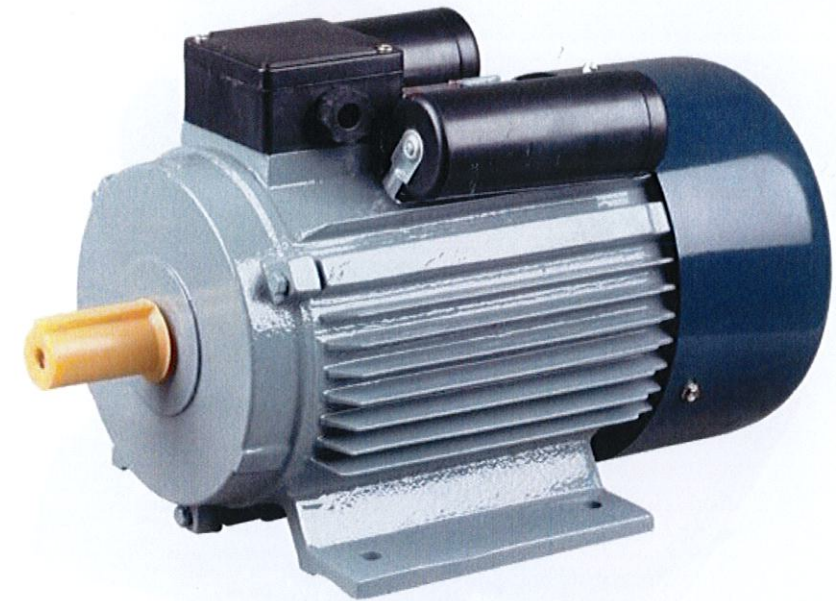
3.7. ASYNCHRONOUS MOTOR

Figure 3.5 : Asynchronous motor

Figure shows the asynchronous motor that used in this project. YC series motors are totally enclosed fan cooled (TEFC) heavy-duty single-phase capacitor start induction motors. It is available for driving small size machine equipment. This motor are really can accommodate the weight of the patient of coma that informed comatose weight are very high compared to the normal person because of the pressure are totally depend on itself that cause the comatose cannot hold their pressure.

3.8.   RACHET BELT

Figure 3.6 : Rachet Belt

Figure 3.6 shows the rachet belt that used in this project. This belt was used because of its strongest that able to hold the heavy load. Endless Ratchet Strap, 2 piece endless ratchet straps, breaking strength 500 kg, safe working capacity 250 kg. Weather resistant nylon webbing. Hila tools are build to quality standard using fine materials and designs.
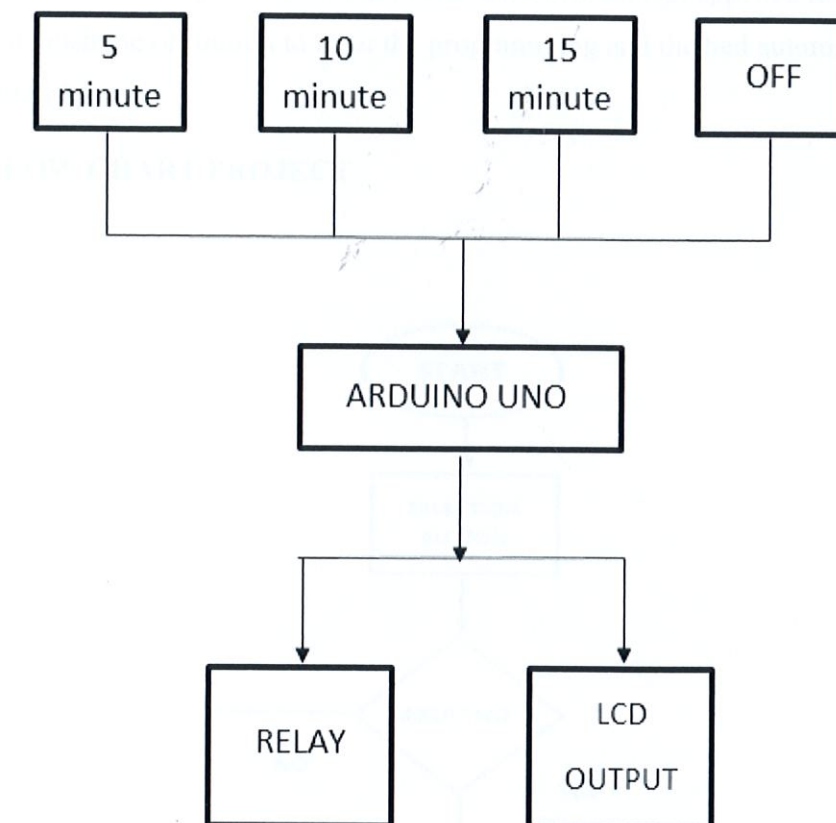
3.9.   BLOCK DIAGRAM PROCESS

Figure 3.7: Block Diagram Project

Block diagram above shows the activities of this project.Based on the figure above, we using the Arduino Uno, that are programming to set the timer about 15 minutes and to get the output. First step is, we have to choose the time that needed for the comatose which is 5 minutes, 10 minutes and the last one is 15 minutes.

After we choose the right time needed, the time will be display on the LCD Screen to show the time choosen to prevent any mistaken.

Next, after the confirmation about the selection time, the bed will rotate , and the speed was depend on the weight of comatose, and the comatose will staying upside down

for the time choose. The last process which is after having enough time of upside down , the bed will back to it normal.

In case there is any emergency case like have something happened to the comatose, then we can push the off button to reset the programming and the bed automatically return back to normal.
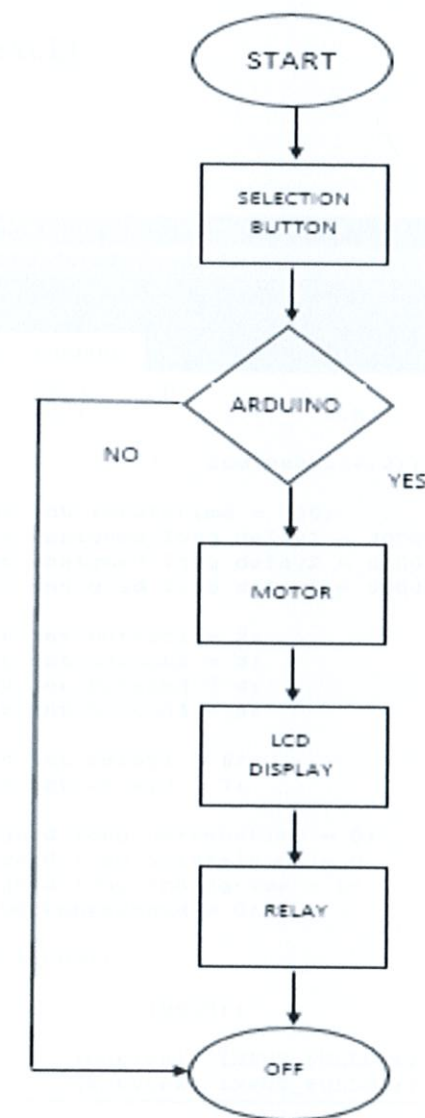
3.10   FLOW CHART PROJECT

Figure 3.8 : Flow chart Project

The flow chart above are the process how the bed therapy functioning. It just the 1 set time has been shown because for the second and third, the process was same. It just repeat the same process.

3.11.   SOFTWARE

These are the software planned to use in this project :-

- Arduino IDE
- MICROSOFT eXCEL
- SSPS

3.11.1 Arduino IDE

```
Main_Coding | Arduino 1.8.5
File  Edit  Sketch  Tools  Help

Main_Coding
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x27,16,2);

const int rotatetime = 100;
const unsigned long delay1 = 300000;
const unsigned long delay2 = 600000;
const unsigned long delay3 = 900000;

const int button1 = 2;
const int button2 = 3;
const int button3 = 4;
const int button4 = 5;

const int relay1 = 6;
const int relay2 = 7;

unsigned long currenttime = 0;
unsigned long initialtime = 0;
unsigned long endingtime = 0;
int buttonpressed = 0;

void setup()
{
  Serial.begin(9600);

  pinMode(button1, INPUT_PULLUP);
  pinMode(button2, INPUT_PULLUP);
```
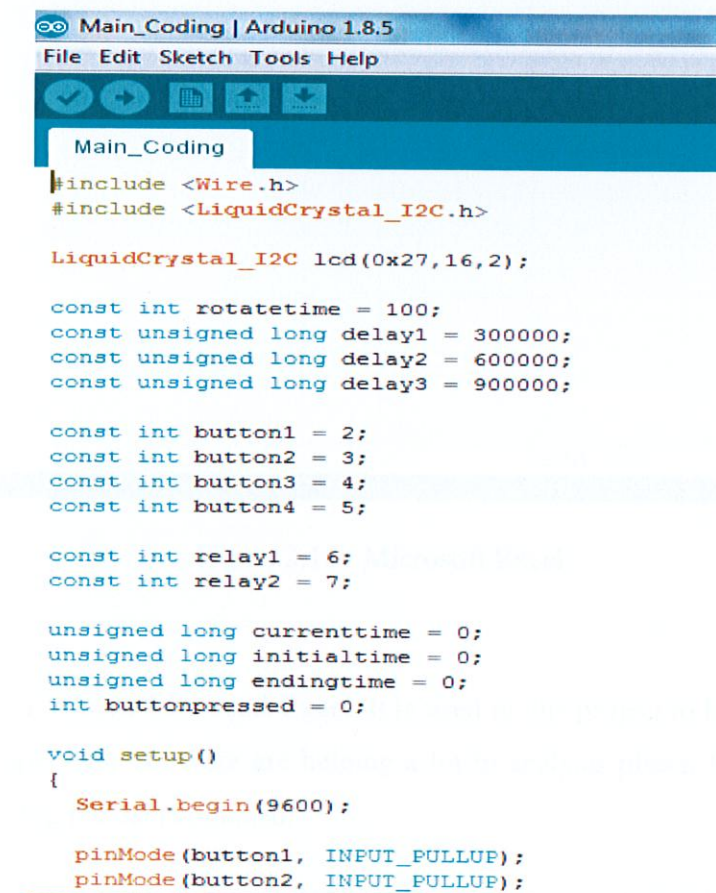
Figure 3.9 : Arduino UNO

Figure shows Arduino IDE. The open source Arduino software makes it easy to write code and upload it to the board. It runs on Windows, MacOS X, and Linux. The environment is written in java based on processing and other open source software.
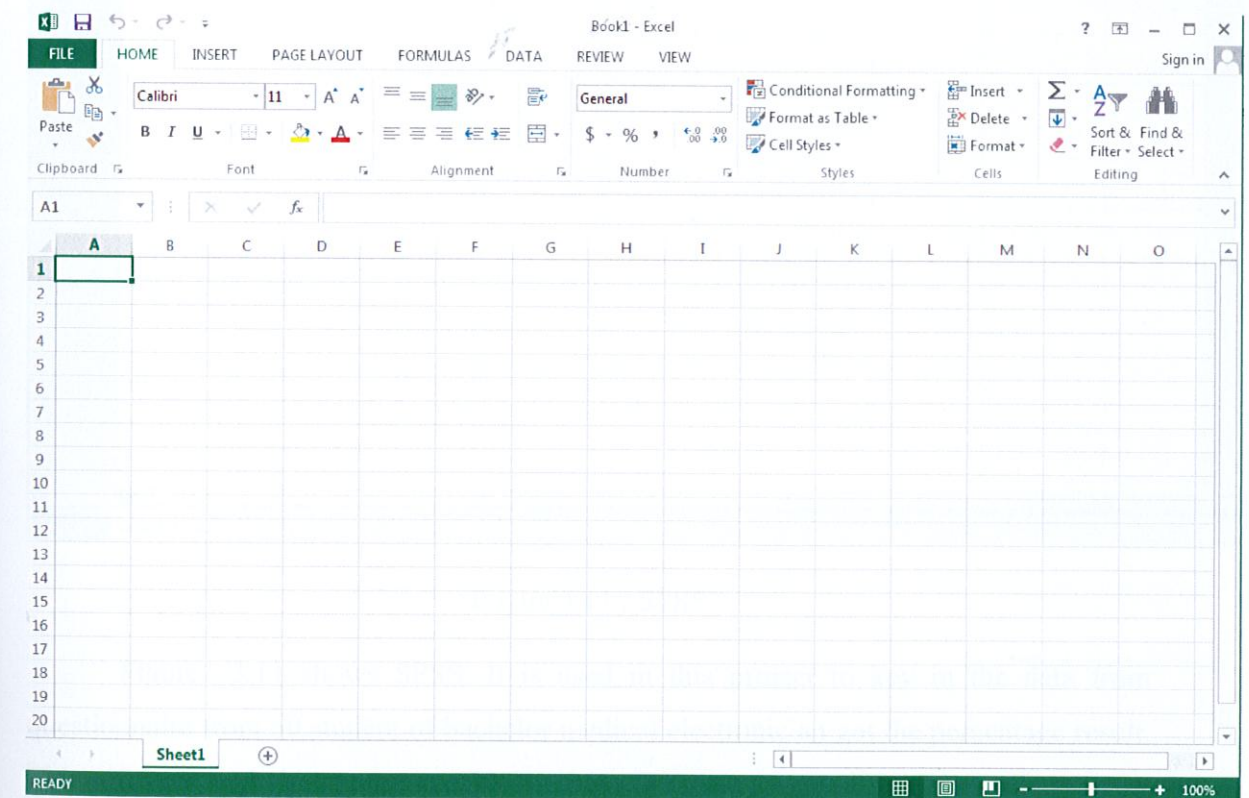
3.11.2 Microsoft Excel

Figure 3.10 : Microsoft Excel

Figure 3.10 shows Microsoft Excel. It is used in this project to key in the data and convert into graph. This software are helping a lot in analysis phase. It create the graph automatically using the data collected.
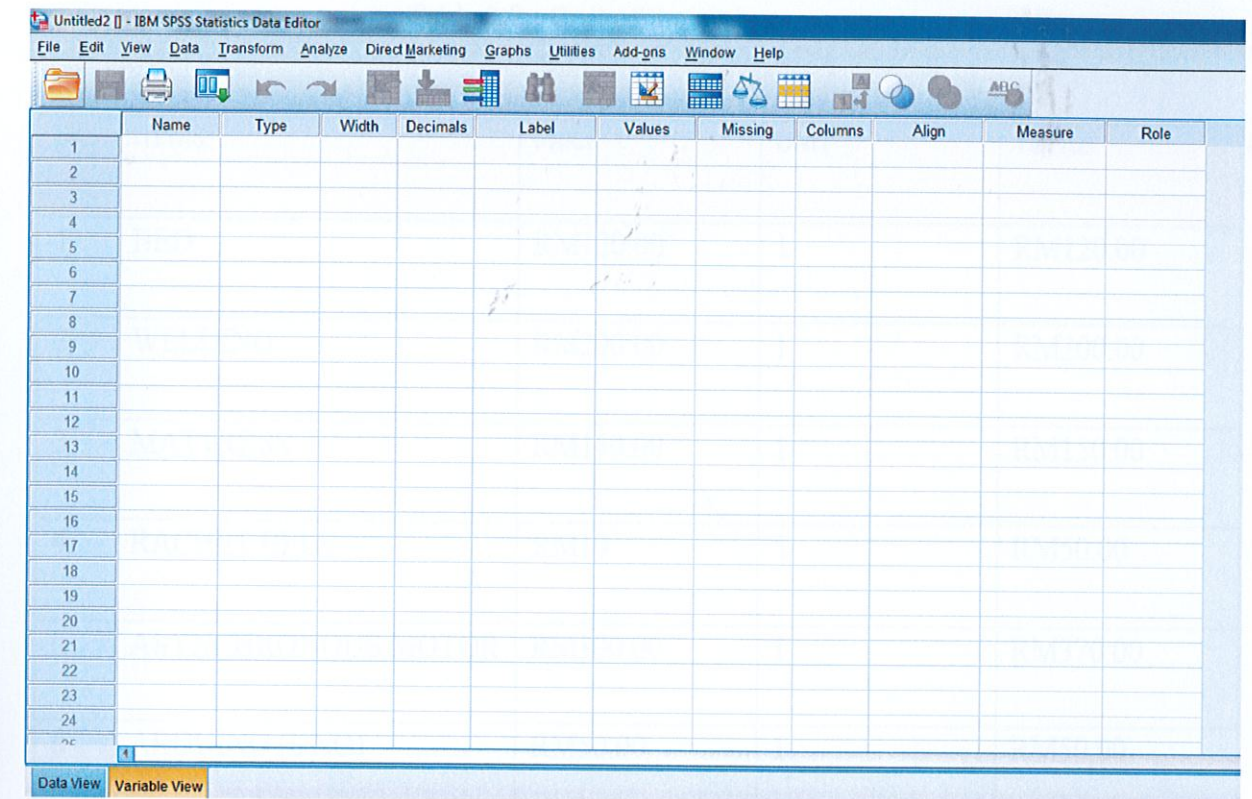
3.11.3 SPSS

Figure 3.11 : SPSS

Figure 3.11 shows SPSS. It is used in this project to key in the data from questionnaire from 50 student of bachelor medical electronic an got the percentage result. This software are helping a lot in analysis phase. It create the graph automatically to make clearer about the result of data collected.

3.12   COST OF THE PROJECT

Table 3.2 : Cost of the project

BIL	ITEMS	PRICE	UNIT	TOTAL
1	BED	RM120.00	1	RM120.00
2	WELDING	RM200.00	1	RM200.00
3	MATTRESS	RM150.00	1	RM150.00
4	RACHET BELT	RM10	5	RM50.00
5	ASYNCHRONOUS MOTOR	RM300.00	1	RM370.00
6	ARDUINO (UNO)	RM50.00	1	RM50.00
7	RELAY	RM10.00	2	RM20.00
8	LCD SCREEN	RM30.00	1	RM30.00
9	CASING	RM50.00	1	RM50.00
10	OTHERS COMPONENT	RM40.00		RM40.00
			TOTAL	RM1080.00

Table 3.3 : Gantt Chart of the project for second semester

Week / Progress	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Choose project title	■	■												
Make research			■	■	■	■	■	■	■	■	■	■	■	■
					■	■	■	■	■	■	■	■	■	■
Initial proposal			■	■										
				■										
Development the device								■	■	■	■	■	■	■
								■	■	■	■	■	■	■
Defend proposal							■	■	■	■	■	■	■	
												■	■	
Log book	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Table shows the Gantt chart of the project for semester 1. It is a plan to conduct on this project. On week 1 and 2 the project progress was choosing the title of project and write the report in log book. On week 3 until 4 is the time to make a preparation for initial proposal also make a research about this title and write the report on log book. On week 7 until 13 was planned for an defend proposal.

Table 3.4 : Gantt Chart of the project for second semester

Week / Progress	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Development of the device	�	▓	▓	▓	▓									
Collect data				▓	▓	▓	▓	▓						
Thesis writing		▓	▓	▓	▓	▓	▓	▓	▓	▓	▓			
VIVA												▓	▓	
Log book	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓

Table shows the Gantt chart of the project for semester 2. It is a plan to conduct on this project. On week 1 and 6 the project is development of device and write the report in log book. On week 4 until 8 is the time to collect the data from surveying questions and also write the report on log book. On week 7 until 14 was planned for a thesis writing. On week 12 and 13 is a VIVA presentation.

CHAPTER 4

RESULT AND DISCUSSION

4.1   INTRODUCTION

This chapter presents the result of the study that were conducted based on the method described in the chapter 3. The data obtained throughout the study were analyzed and interpreted. Summaries of result are generally presented in figures. Typical graphs and tables relating to the experiments will be provided in this chapter. This chapter describes the analysis of data followed by a discussion of the research findings. The findings related to the research question that guided the study. Data were analyzed to identify and explore the relationship between severity of bed sore patients, level of speed, comfortableness of bed and safety of the bed therapy by the purpose to help the patients with bedridden diseases.

Figure 4.1 : Final output of Bed Therapy hardware

4.2   EVALUATION TEST REFERRING TO COMFORTABLENESS

Table 4.1 : Evaluation test on comfortableness

Comfortableness	Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
1(a)	9	29	12		
1(b)	8	36	6		
1(c)	8	33	9		
1(d)	11	35	4		
1(e)	8	33	9		

Notes :

1(a) I was found this Bed Therapy is easy to used and friendly.

1(b) Bed Therapy was modified from the original and has been added on with motor to help Bed Therapy rotate automatically, the design is suitable and comfortable.

1(c) During therapy session, the position of comatose is consistence while rotate.

1(d) Tthe bed sheet can be change for comatose hygiene.

1 (e) The main function of bed therapy was same one with the normal bed except the rotation for therapy.
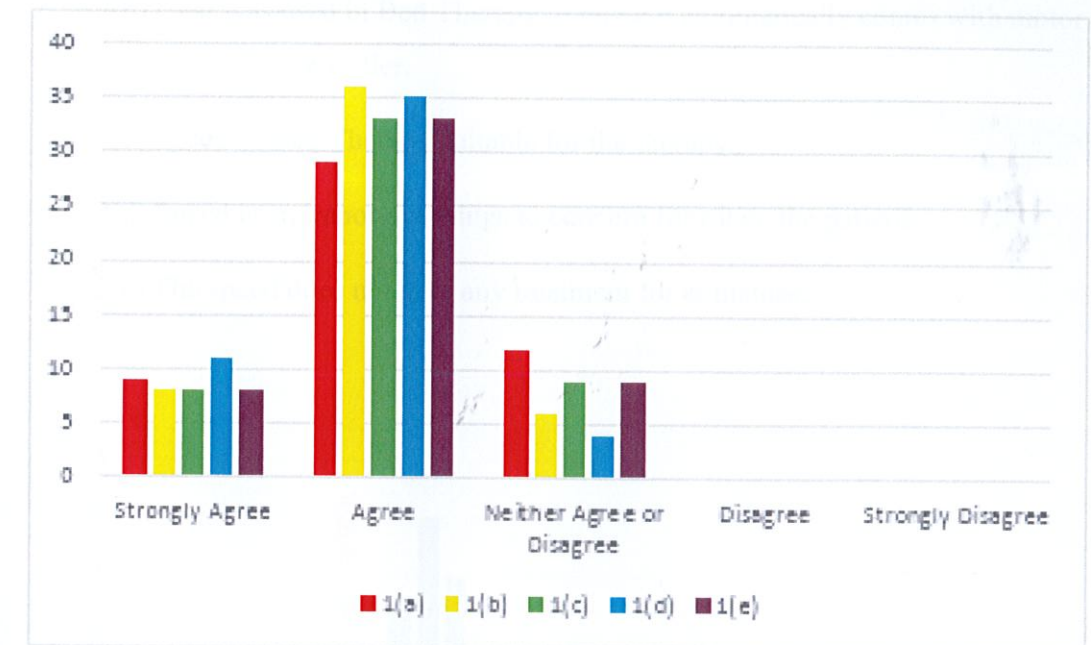
Figure 4.2 : Graph evaluation test on comfortableness

4.3 EVALUATION TEST REFERRING TO SPEED USABILITY

Table 4.2 : Evaluation test on speed usability

Comfortableness	Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
2(a)	6	32	9	2	1
2(b)	8	30	12		
2(c)	9	22	19		
2(d)	14	30	6		
2(e)	10	25	13	1	1

Notes :

2(a) Speed of motor can be variable depend on weight of comatose.

2(b) Gear was used in Bed Therapy to move it automatically comes with motor controller.

2(c) Speed of Bed Therapy suitable for the therapy.

2(d) Speed is an important things to concern for rotate the patient.

2(e) The speed does not give any treatment for comatose.
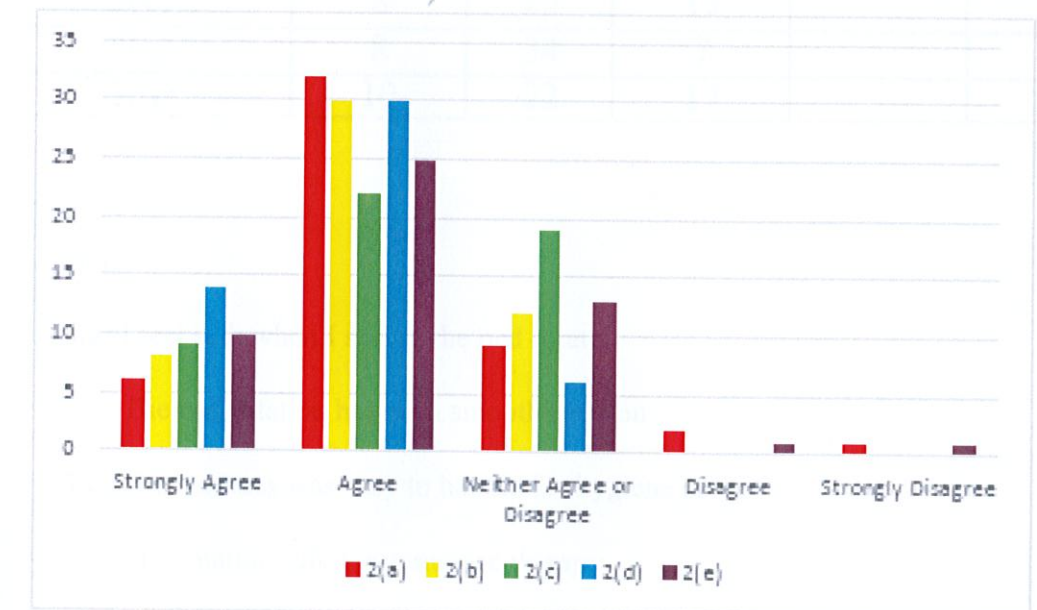
Figure 4.3 : Graph evaluation test on speed usability

4.4 EVALUATION TEST REFERRING TO MATTRESS AND ROTATION

Table 4.3 : Evaluation test on mattress and rotation

Comfortableness	Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
3(a)	6	24	17		3
3(b)	8	25	15		2
3(c)	8	34	7		1
3(d)	10	22	17		1

Notes :

3(a) I feel safe when I seeing the bed rotate.

3(b) The bed rotation having a smooth rotation.

3(c) The mattress was easy to handle for hygiene care.

3(d) The rotation safe for comatose therapy.

3(e) The mattress suitable for daily use.
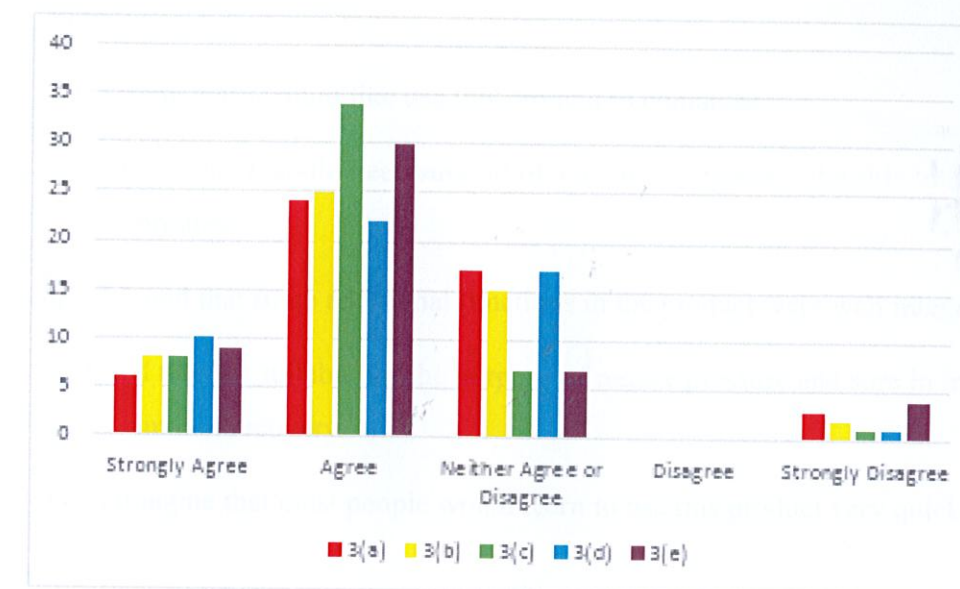
Figure 4.4 : Graph evaluation test on mattress and rotation

4.5   EVALUATION TEST REFERRING ON EFFECTIVENESS

Table 4.4 : Evaluation test on effectiveness

Comfortableness	Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
4(a)	9	34	7		
4(b)	12	30	8		
4(c)	8	34	8		
4(d)	12	29	9		
4(e)	14	26	10		

Notes :

4(a) I think that I would like use this product to comatose.

4(b) I think that I would need support of a technical person to be able to use this product.

4(c) I found that some additional functions in the product were well integrated.

4(d) Bed therapy suitable for the purpose of reduce pressure and sore in increasing time of recovery.

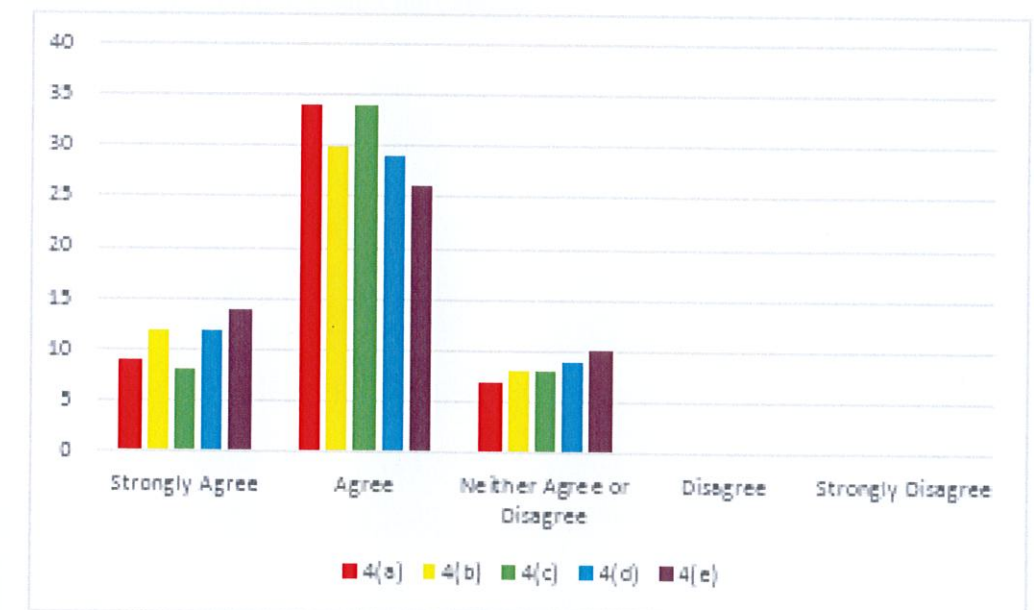4(e) I imagine that most people would learn to use this product very quickly.

Figure 4.5 : Graph evaluation test on effectiveness

4.6   CONCLUSION FOR EVALUATION TEST

Evaluation test was analyzed in 4 terms which is comfortableness during rotation, speed usability, accordingly to mattress and rotation and also the effectiveness of pedal

exerciser. The evaluation test was conducted to 50 subjects. As we can see in table 4.2, most of the subjects agree and some of them strongly agree and some of them was not sure about the comfortableness during rotation. In addition they are also found that bed therapy are friendly user which is it is easy to handle. Subjects are also agreed that the this bed therapy was safe to use to comatose patient and the result shown on the table 4.3.

For the evaluation test on the ability of speed, most of the subject agree compare to the not sure and strongly agree about the speed of bed rotation. But for the effectiveness of bed therapy for people could learn this quickly, most of them answered neither agree or disagree because they was not pretty sure about how to handle this bed therapy yet and some of them was not exposed to this deeper. Last but not least, the analysis on table 4.4 shows that this bed therapy was effective to the user and most of them are strongly agree to that and it is proven in the bar chart above.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

In conclusion, almost 90% of the objective in this project was archived. This projects implements and the innovation of this project may help the comatose to reduce the pressure and also can prevent the comatose from having the decubitus ulcer. The usage of asynchronous motor might no be very suitable for this bed therapy and this problem will be improve in future to change the asynchronous motor to the suitable one that can be manage the speed by programming. This project also innovate the new design that had been used in Dakha Hospital to the automatic one which having the combination electronic part and the programming part, and the combination both of it was success. The innovation in this project to reduce the energy of medical staff was also success and should be improved in safety to the comatose.

As a recommendation for future, the motor should be change to other motor so that the speed of motor can be controlled by the programming that used and for sure the stronger one that can accommodate the weight of comatose. This product are made up of moderate costing but good quality, so that the price would be affordable for user to buy to be use at home for personal guardians. It functions also helpful to the normal to make it as a normal bed and et.

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[23]

POLITEKNIK
Jabatan Pengajian Politeknik

Development of Bed Therapy For Comatose

Thank you for taking time to fill in this questionnaire, you will remain anonymous. The objective of this questionnaire is to get some data through the range of agree or disagree of information about Bed Therapy. Please indicate the extent to which you agree or disagree with the following statements by putting a √ in the appropriate box.

NO	STATEMENT/QUESTION	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
1	Bed therapy regularly used either at home or in Intensive Care Unit (ICU)					
2	The frequency of using Bed Therapy is every 2 hour					
3	Bed Therapy only can be used to comatose only					
4	Bed Therapy has problem and need to be improved					
5	Comatose who using bed Therapy can slipping during rotate session					
6	The slipping issue of Bed Therapy can make comatose less protection					
7	Bed Therapy make noisy sound when switch on the motor					
8	That noisy sound disturbing emotion and user's concentration during therapy.					
9	Bed therapy can help a comatose to reduce the pressure for bedridden					
10	The frequent using bed therapy prevent comatose from having sore.					

APPENDIX B

Consent form

Title of study : Development of Bed Therapy For Comatose

I understand about the information of this study and received explaination from the investigator about the purpose of the investigation, including benefits and risks.

I am _____, identity card number _____, phone number _____,

*Agree/disagree to participate in the studies as describe above.

Signature,

_____

Date :

Boring Kebenaran

Tajuk kajian : Pembangunan Katil Terapi Untuk Pesakit Koma

Saya memahami mengenai maklumat kajian ini serta mendapat penjelasan lanjut daripada penyelidik mengenai tujuan penyelidikan termasuk faedah dan risikonya.

Saya_____, nombor Kad Pengenalan _____ , nombor telefon _____,

*Bersetuju/Tidak Bersetuju untuk menyertai kajian yang dinyatakan seperti diatas.

Tandatangan,

_____

Tarikh :

POLITEKNIK
Jabatan Pengajian Politeknik
POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

Development of Bed Therapy for Comatose

Thank you for taking time to fill in this questionnaire, you will remain anonymous. The goal of this questionnaire is to get some data through the range of instrument usability about Bed Therapy. Please indicate the extent to which you choose with the following statements by putting a √ in the appropriate box by following the range.

Age   :   18-22 ☐   38-42 ☐   Gender: F ☐   M ☐
            23-27 ☐   43-47 ☐
            28-32 ☐   48-52 ☐
            33-37 ☐

Occupation: _____

Do you having facing this problem? : _____

If you have someone facing this condition, what is the cause?
: _____

What kind of the treatment used? :_____

How many times that therapy used in a week?
: _____

No	Item & Elements	Strongly Disagree	Disagree	Neither agree or Disagree	Agree	Strongly Agree
1	**COMFORTABLENESS**					
	a. I was found this Bed Therapy is easy to used and friendly	☐	☐	☐	☐	☐
	b. Bed Therapy was modified from the original and has been added on with motor to help Bed Therapy rotate automatically, the design is suitable and comfortable	☐	☐	☐	☐	☐
	c. During therapy session, the position of comatose is consistence while rotate.	☐	☐	☐	☐	☐
	d. The bed sheet can be change for comatose s hygiene.	☐	☐	☐	☐	☐
	e. The main function of bed therapy was same one with the normal bed except the rotation for therapy.	☐	☐	☐	☐	☐
2	**SPEED**					
	a. Speed of motor can be variable depend on weight of comatose.	☐	☐	☐	☐	☐
	b. Gear was used in Bed Therapy to move it automatically comes with motor controller.	☐	☐	☐	☐	☐
	c. Speed of Bed Therapy suitable for the therapy	☐	☐	☐	☐	☐
	d. Speed is an important thing to concern for rotate the patient.	☐	☐	☐	☐	☐
	e. The speed does not give any treatment for comatose.	☐	☐	☐	☐	☐
3	**MATTRESS & ROTATION**					
	a. I feel safe when I seeing the bed rotate.	☐	☐	☐	☐	☐
	b. The bed rotation having a smooth rotation.	☐	☐	☐	☐	☐

	c. The mattress was easy to handle for hygiene care.	☐	☐	☐	☐	☐
	d. The rotation safe for comatose's therapy.	☐	☐	☐	☐	☐
	e. The mattress suitable for daily use.	☐	☐	☐	☐	☐
4	**EFFECTIVENESS**					
	a. I think that I would like use this product to comatose	☐	☐	☐	☐	☐
	b. I think that I would need support of a technical person to be able to use this product.	☐	☐	☐	☐	☐
	c. I found that some additional functions in the product were well integrated.	☐	☐	☐	☐	☐
	d. Bed therapy suitable for the purpose of reduce pressure and sore in increasing time of recovery.	☐	☐	☐	☐	☐
	e. I imagine that most people would learn to use this product very quickly	☐	☐	☐	☐	☐

Other recommendation for the purpose to improve Bed Therapy

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