

**SMART balance test Innovation**  
**Development tools : Simple , Cheap , Accurate , Responsible , and Measured**  
**with a digital approach**

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Abstract

Balance is a manifestation of the quality of a person's muscles and nerves . Today many people less attention to the element of balance in exercise. When the balance is an important element in daily activities. This study aims to develop a measuring balance with a digital approach . This study was included in research and development is done in a period of 3 years . This tool uses design innovation microcontroller system and infrared sensors . The results showed that the balance of the assays has measurement functions 4 samples at a time , using energy saver battery , capable of storing measurement data are quite a lot , portable and measurement results can be directly downloaded into the computer . Based on logical validity is valid because the measure tool compatible with the to be measured . Conclusion that innovation gauges static balance has been resolved , and declared valid with logical validity. The next stage will be a tool used to measure static balance to the athletes , non- athletes , diabetic patients , coronary heart disease , disability students and elderly.

Key words : development , tools , measurement , balance

## INTRODUCTION

This research is in order to realize the idea according to the market demands of a real product , which is then carefully to get a clear specification variations and has the distinction of which is a competitive advantage , which is the next stage of the tools that have been studied , can be patented in the name of college high and in production to serve the needs of the market . This study is also a form of follow-up realization and development of science and technology modifications Fundamental Decentralization Grant Program UNY .

At each appearance of sport skills required quality biomotor good component capabilities , which include strength , speed , force ( power ) , endurance , flexibility , agility , balance and coordination ( Iskandar and Kosasih , 1999: 3 ) . To be able to know how well the biomotor components , necessary instruments or measuring devices are qualified to be used in test and measurement exercise ( sports measurement and evaluation ) . Here the team will examine the development of modified instrument to measure the balance test , which has been in the test instrument known by the term standing balance test .

Simply put how technical testing capabilities on the standing balance test balance is Testi standing on one leg test tool that has been provided with the eyes closed state / Strock stand . Subjects during the test - the length and then recorded how long it can withstand kesimbangannya (Widiastuti, 2011:144 ).

Technically and its implementation method is needed supplies tend to be very different from the gauge / instrument that had been used , but here the problem is on the device which has been widely used , test tools tend to be difficult / not flexible when about to be moved due to arrangement of equipment and tools that are too much on the development of tools " SMART " ( simple , Cheap , Accurate , Responsible , and Measured ) balance test modification , which promises a different feel later on when they want to perform tests and measurements , this tool can be much easier to taken - take it and move on - move .

The test instrument is very in craved by athletes who did after getting the right exercise program so biomotornya ability to increase significantly the measurement capabilities that biomotor really - really can be much more precisely with pre-existing conditions such as the data already in the can . Thus, in this case , the central and local KONI , Faculty of Sport and center - sports training center in Indonesia , because the instrument is needed in Indonesia, thus the presence of such instruments in the measurement process capability biomotor expected to be steady and standard can be more clear and precise and is more accurately measured in accordance with the requirements of the biomotor capabilities .

As a form of development or modification of existing tools mentioned above , it is considered to be the need to make development tool " SMART " ( Simple , Cheap , Accurate , Responsible , and Measured ) balance test modification and the tool can also be registered so that adds to its intellectual property wealth of Indonesian products . Another impact will provide opportunities in the domestic industry to innovate design measuring instruments biomotor other components , and formed a partnership with universities in developing the sports industry .

Specifically this study aims : first , to realize / modification provides development capabilities biomotor special gauges to test balance measurement and evaluation capabilities biomotor , and both are able to acquire intellectual property rights . The process of goal achievement is done through the following steps :

- 1 . Development of test and measurement instruments by modifying the tool of examples of tools that already exist today to the complex nature of the tool that is simple .
- 2 . Conduct laboratory testing techniques to the tools in terms of function , service , sustainability , performance and appearance .
- 3 . Evaluating such tools .
- 4 . Refine the tool .
- 5 . Disseminating these tools to KONI and center - sports training center .
- 6 . Market test / test user / field testing .
- 7 . Based tools enhance the input - input and demands a candidate - a candidate instrument users .
- 8 . Participate in developing the sports industry in Indonesia.
- 9 . Obtaining intellectual property rights over those KONI or tool center - sports training centers in all corners of Indonesia , the results of this research is the development of measurement tools that have the ability biomotor juga modified and remains easy to use , maintain , prices and equipment maintenance costs are relatively affordable to raise the quality of athletes .

For universities , this study is the work of innovation and creativity in modifying existing tools with more capabilities renewable tool that can be developed at the same time proud and will bring up the relevant universities , and most importantly, is also an encouragement and stimulus for further work for the Faculty of sport Sciences in the field of engineering tools and sports industry development . And more than that , this work is an example that can encourage program - courses in universities to create a cooperation network traffic used in the manufacturing field .

For industry, an industry collaboration and new opportunities in the field of Higher Education and the Sports Industry at once an opportunity and a challenge for the industry to create and innovate further on tools - tools for realizing other supporting facilities sports equipment, modification or adoption of the system.

For students, involvement in the design, manufacture, testing, sale, and acquisition of intellectual property rights is the pride and real experience in working independently or in cooperation.

#### Targeted Results

Development tool "SMART" (Simple, Cheap, Accurate, Responsible, and Measured) balance test complex modification of the tool was developed in order to meet the needs of the domestic market and the needs of today's athletes which has a lot of athletes are capable of more than the maximum of the measuring instrument that there is, in addition to the performance tool was tested with calaon - potential users and will be enhanced according to the input - input from the user. Not only the performance test, to complement the reliability of this tool will be tested functions, test services, test and continuity test.

## LITERATURE REVIEW

Development tool modification " SMART " ( Simple , Cheap , Accurate , Responsible , and Measured ) balance test this modification is designed using principal components consisting of a spiral spring , and potentiometers , sensors , computers , ADC , microcontroller , and programs . Advantage of this tool is able to measure agility digitally . This development tool is a modification of the existing test instrument with the excess can be directly digitally can automatically display the results of the test scores the old instrument to meet the needs of sport gauges that are economically profitable when manufactured , consideration of the user is purchasing power , benefits , reliability , easy to use . Consideration of the designer and maker is sophistication , ease of finding parts , ease of production .

### A. balance

Equilibrium ( balance ) : The ability of a person to control the organs that are neuro - muscular ( Andi Suntonda.S , 2009: 55 ) . In line with that expressed by Widiastuti ( 2011: 144 ) who also explained that the equilibrium ( balance ) to maintain posture and proper body position while standing ( static balance ) or during movement (dynamic balance) .

### B. designing

Type of product design according to Krutz (2000 : 5 ) classified :

- 1 . Original , which is the discovery that the design is completely based on the discovery never before
- 2 . Developer ( modification ) , which merupakan development of existing products in order to increase efficiency , effectiveness , performance , or the competitiveness to meet the demands of the market or the times .

According Espisito and Thower (2001 : 6 ) need to answer the following questions :

- a. Is the product memenuhi human needs ( market needs ) ?
- b . Is the product able to compete with its rivals ?
- c . Is the product easy to maintain ?
- d . Is economical to produce products or profitable ?

Furthermore , Beam (1999 : 30 ) says that the product is designed to be considered in terms of users , makers and designers .

Consideration of the user side is the appearance , speed , ease of use , size , weight , benefits , reliability , ease of use , ease maintained , not expensive operating costs , purchase price , safety , comfort , and ergonomics . Consideration of the designers and makers are manufacturing cost , selling price , ease of test , age , availability of spare parts , recency , designed ease , competitiveness , kemudahan made , simplicity , market demands , and storage and disposal .

One kind of design is the development of existing products , where it is necessary to realize the modification ( Hurst. K , 2006: 30 )

Modified objectives include:

- a. The demands of the market / demands of the times .
- b . Progress / development of science and technology .
- c . Need excellence product ( market competition competitiveness )
- d . The need to adapt to the viewing capabilities tools / equipment / machinery / resources / materials manufacturing process is held to existing components .
- e . Any desire to be made cheaper
- f . In order for the product in question can be used again
- g . Lack of spare parts
- h . So that maintenance is easier and cheaper

Further, the modification should make a difference, which is a change from the old tool. Ma'asud and Mahmud (2004: 35) modification is to give different look with pre-existing items.

Suatau differences can be developed that meets the following requirements: important, obviously, superior, communicative, precede, affordable and profitable, meaning that the average difference

between providing enough benefits to customers the difference was not / belum dimiliki the lai, the difference was much better than the way lain mendapatkan same benefits, the differences can be understood by the user / buyer, the difference is not easy to imitate competitors, buyers can menjangaku price difference, and the difference was financially beneficial and rare intact penrancangan by Gupta and Muthy (TTH: 27).

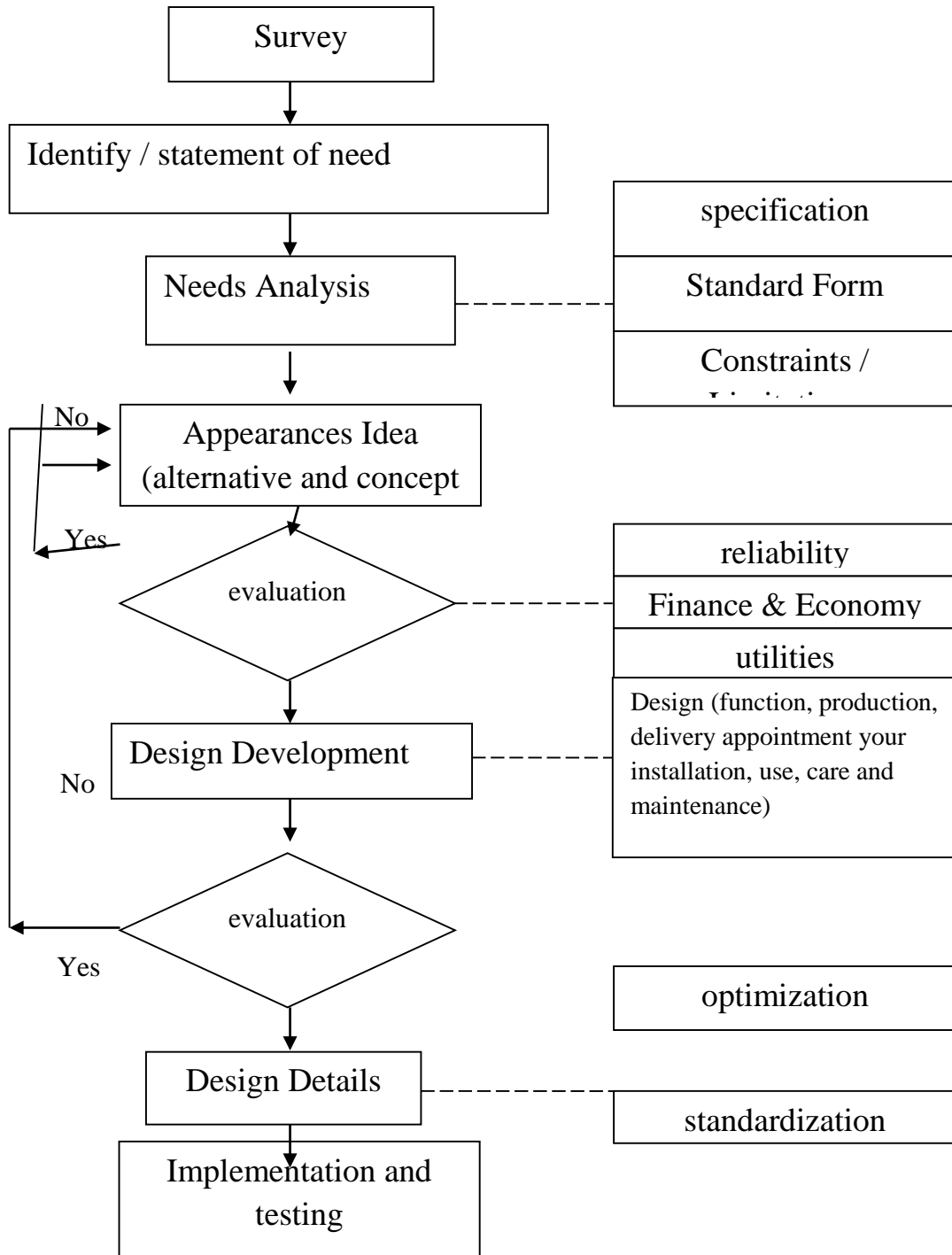


Fig.1. Step Design

### C. spring

Function of the spring , according to Khurmi and Gupta (2001 : 752 ) , is to direct the force , measure the force , store energy , dampen vibration . Further it is said that this type of spring is Helical Spring , Conical Spring , Torsion Spring , Leaf Spring , disc of Belleville spring .

Term - the term in the spring is the free length , compressed length , and solid length , while the other terms associated with spring is the spring index formula and spring rate .

Basic formulas spring :

- 1 . Spring index =  $D / d$
- 2 . Spring rate =  $W / \delta = \text{Konstant}$
- 3 . Generally spring load is a load for a spring press firmly and load punter .
- 4 . Maximum voltage =  $\{ 8 WD / ( d ) \} * \{ ( 1 + ( 1 / 2C ) ) \}$
- 5 . Styles  $P = - kx$  ( Suharto , 2002: 7 )
- 6 . Power  $N = ( 1/2 k.x ^ 2 ) / ( 1000.t. 75 )$
- 7 . Velocity  $V = x / t$
- 8 . Style is retained by many springs in parallel  $k = k1 + k2 + \dots + kx$  .
- 9 .  $D$  is the diameter of the spring , spring wire diameter  $d$  ,  $B$  load ,  $\delta$  decline ,  $W$  load , compressive force  $P$  ,  $k$  komstante spring , and  $x$  deflection of the spring , shortening the time  $t$  , and  $N$  power

### D. Research roadmap

Table 1. research roadmap

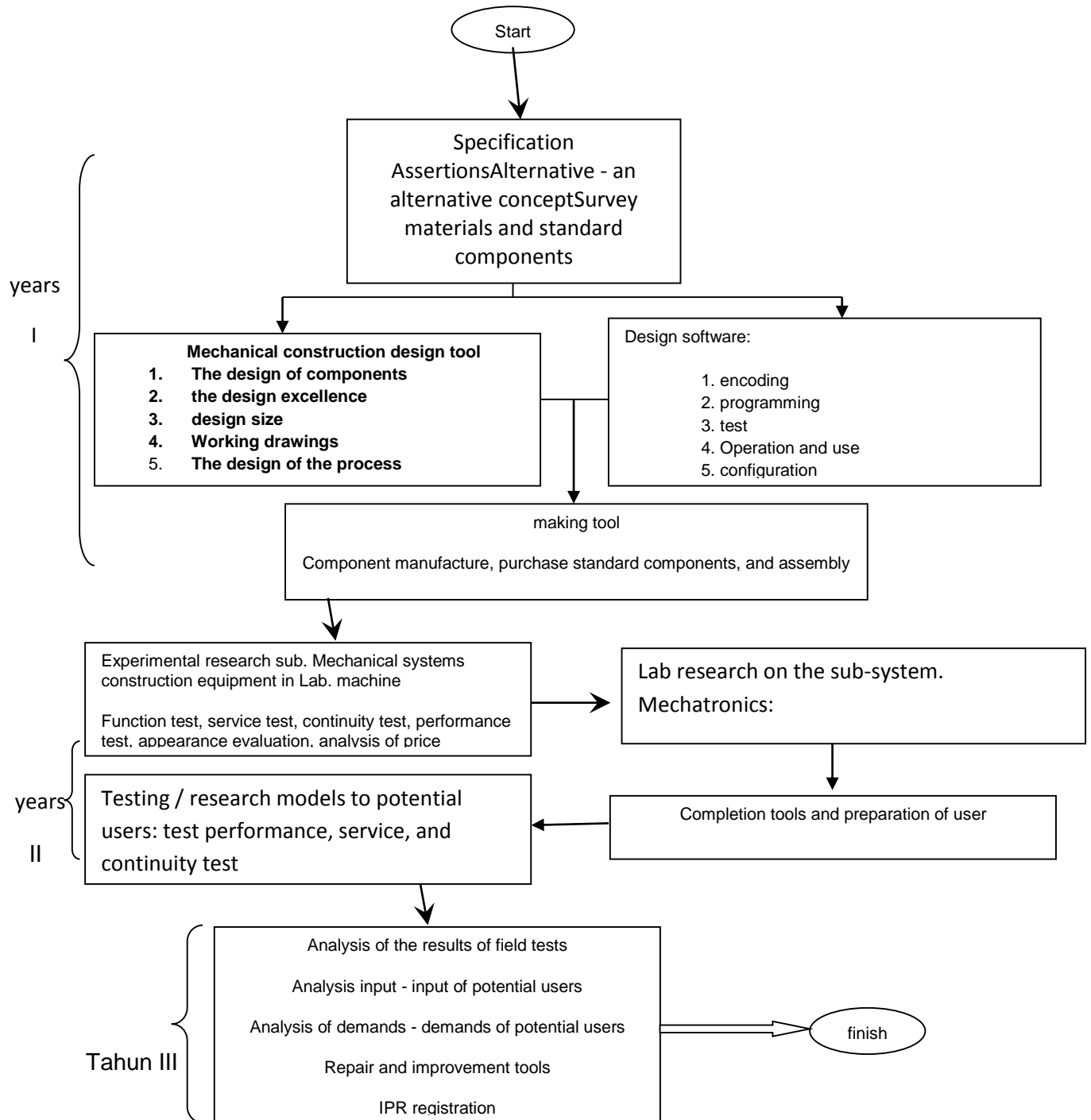
Related research has been done	Research to be conducted	Continued research will come	Finalization of last follow-up study
The data showed that equilibrium assay that has been there tends to be complex so it is difficult to be brought where - where, in the moving and storage place. With adanyapengembangan tool "SMART" (Simple, Cheap, Accurate, Responsible, and Measured) balance test this modification is designed to provide convenience to the user if want to carry, store, operationalize. The tool is only as biased scales folded but still based digital for recording the results of the test scores.	Assembly / formulation development tool "SMART" (Simple, Cheap, Accurate, Responsible, and Measured) balance test a prototype modification.	1. Testing tool development tool "SMART" (Simple, Cheap, Accurate, Responsible, and Measured) balance test modification to prospective users and the relevant interest 2. Scientific publications both nationally and internationally	Tool development tool "SMART" (Simple, Cheap, Accurate, Responsible, and Measured) balance test can be tested and the modification has been proposed to obtain IPR

## **RESEARCH METHOD**

This study is a research and development. The research design used by Borg and Gall approach. Methods of research and development is a research method that is used to produce a particular product, and test the effectiveness of the product (Sugiyono, 2011: 297). Research and development is a kind of product-oriented research. The resulting product is a development of an innovative tool for measuring static balance ability.

Borg and Gall, 1983, (in Nana Syaodih Sukmadinata, 2006:163) stated that development research procedure basically consists of two main objectives, namely: (1) develop the product, and (2) to test the effectiveness of the product in achieving the goals. The first objective function is called development, while the second is referred to as validation purposes. Thus the concept of the development of more precise research is defined as development efforts are accompanied by efforts to validate.

A. Flow chart of Research



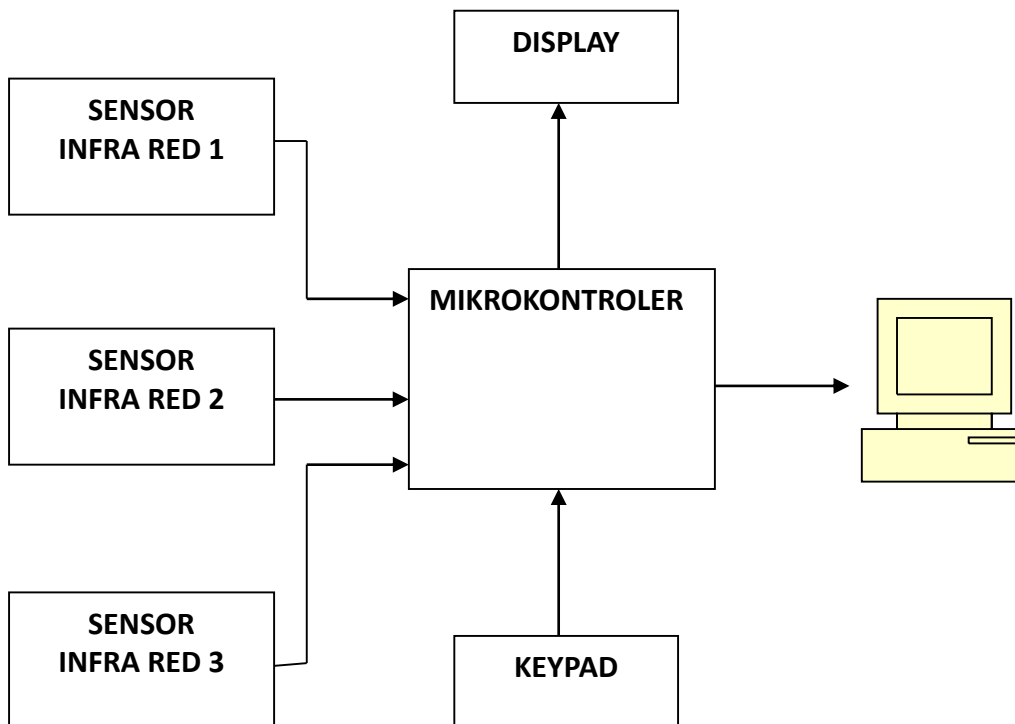


## FINDING RESEARCH

The following is a picture of the mechanism of action of tools developed to measure balance.

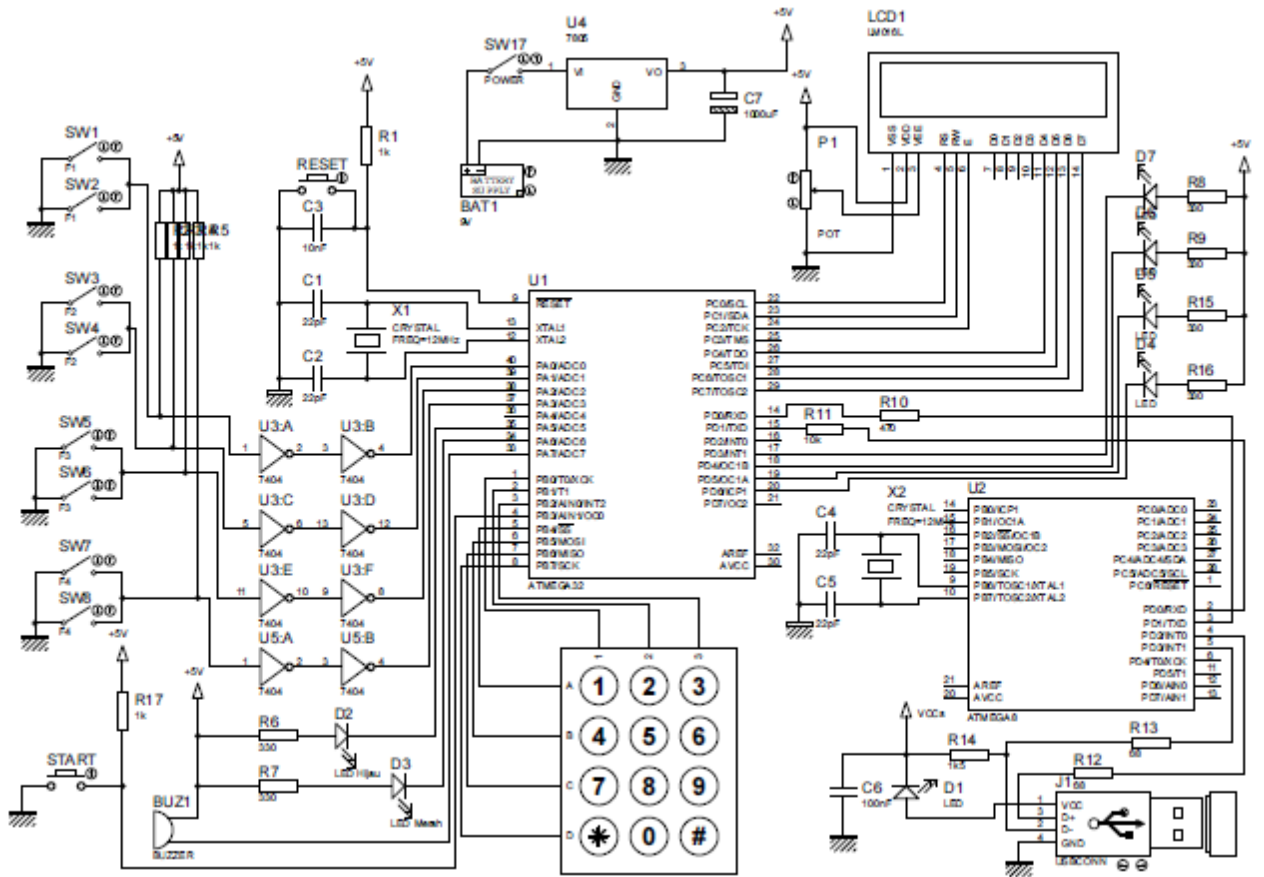
Descriptions balancing tool:

Infra red sensor works by emitting light transceiver part to be received by the receiver section. If the light blocked by the foot of man it will impart information to the microcontroller. Microcontroller will process the information from the sensor by adding up-counter, and will be repeated until the deadline finishes. Amount of time and a matter of feet past the sensor displayed on display. Keypad used to provide input data is no. participants to the microcontroller.

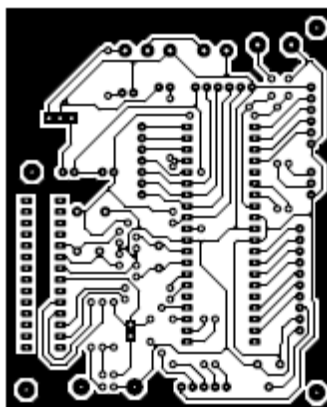
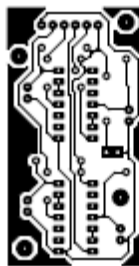


### Spesifikasi Komponen:

Sensor Infra Red	: Tranciever-reicever
Mikrokontroler	: ATmega16
Keypad	: Matrik 3x3
Display	: LCD 4x32



picture: : Schematic balance – layout komp.



picture: : pcb balance

The following is the image of the product development tool for measuring the balance



Picture : a tool for measuring the balance

**COMPARISON OF INNOVATION TEST EQUIPMENT BALANCE**

<b>NO</b>	<b>EXISTING TOOL</b>	<b>INNOVATION</b>
1	Price is quite high	affordable prices
2	foreign products	Domestic products
3	electrical energy	Battery energy recharge
4	There is no memory in the device can be accessed indirectly to laptop	There is a memory that can diconect / copied to the laptop
5	Not Portable	Portable / easy to carry
6	ost tests in the lab.	Can be done in the field
7	One – tree sensor	Four sensor

## Conclusion

This research aims to develop a tool to measure the balance. the results showed that it has completed the manufacture of gauges balance ability. The tool has advantages such as relatively cheap price, domestic production, using a battery recharge, the memory can be connected with computer, easy to carry, can be used in the field and others. This study came to the drafting of innovation, whereas for product testing will be done at a later stage.

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