CHAPTER 3

Research Methodology

1. Identification Problems and Literature Study

The first step in this research is to obtain valid data from the accelerometer and gyroscope sensors which will later be included in the algorithm created. All journals that are included are references that are very helpful in introducing fall detection systems and making it easier for us as researchers to get ideas for placement and design of tools that are comfortable when used by the elderly in their activities.

2. Structure algorithm

It is very important to use filtering methods for sensor output data, because noise or interference will reduce the accuracy of the sensor output values. Therefore, it is necessary to use data filtering methods to overcome these problems. Depending on the sensor type, there are several filter methods that can be applied to the sensor output value, such as the Kalman filter method, complementary internal filter, and sensor filter.

While there are many ways to filter data for different sensors, the goal remains the same, which is to reduce or minimize noise. Complementary filter is a filter method that is not too complicated, because its implementation does not require many variables, only a few variables such as alpha (filter coefficient) and sampling time. The value of the tilt angle of the gyroscope and accelerometer.

3. Implementation with programs

Complementary Filter is a method of filtering, which can serve as a value filter sensor so that the value has low noise, small or even non-existent, so the data is accurate. This method is a combination of high-pass filter coming from the output Integrated gyroscope and low-pass filter which comes from the accelerometer output which has been processed.

Idea behind complementary filters is to take slow moving signals from an accelerometer and fast moving signals from a gyroscope and combine them. Accelerometer gives a good indicator of orientation in static conditions. Gyroscopes give a good indicator of tilt in dynamic conditions. So the idea is to pass the accelerometer signals through a low-pass filter and the gyroscope signals through a high-pass filter and combine them to give the final rate. The key-point here is that the frequency response of the low-pass and high-pass filters add up to 1 at all frequencies. This means that at any given time the complete signal is subject to either low pass or high pass. After that we take the threshold value of upper data and the lower threshold which will later be entered into the formula

$$CF = \frac{(\text{data } 1 * A) + (\text{data } 2 * B)}{(A + B)}$$

Data 1 & Data 2 = Accelerometer

A = load (0.95)

B = load (0.05)

4. Testing

We test this tool by designing it in such a way that is in the form of a belt. Then make a scenario of what activities are carried out by the elderly and practice them when lying down, prone, when tilted left and when tilted right. Then test if the value of the accelerometer and gyroscope data is shown when the elderly do these activities. After that, we also tested the output sensor, namely the buzzer so that it could sound and give a signal when detecting a fall movement in the elderly. Approximately we tested more than 10 times in order to get several data sets of the elderly movement activity. So that there is a match between the sensor input value and the buzzer output so that the buzzer can give a signal to the closest person / people around who are responsible for taking care of the elderly.

5. Analyze

Compared data from volunteer to other volunteer to check the accuracy data therefore we can get a threshold-based valid data.