Investigation Report

Team MediCore Innovations

BM2210 - Bio Medical Device Design

Group Members

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1 Introduction

Medicore Innovations is a startup focused on about biomedical product design and development. We're a bunch of second-year students studying biomedical electronic engineering. Our goal is to shake things up in healthcare and come up with cool, new ways to make medical tech better and easier to get for everyone.

2 Our Strategic Focus

2.1 Mission

Our mission is to transform healthcare by designing cutting-edge biomedical devices that are not only innovative but also highly affordable, with a strong focus on serving the Sri Lankan market.

2.2 Our Focus

Despite our current limits in sophisticated anatomy and complex electronics, Medicore Innovations focuses on creativity and resourcefulness, leveraging the skills of its driven team of undergraduates. Through leveraging a solid basis in fundamental electronics and an unwavering dedication to education, the firm hopes to enhance healthcare accessibility and cost. They focus on developing affordable biomedical devices that satisfy the needs of healthcare providers, NGOs, government agencies, and people looking for affordable medical solutions, while overcoming obstacles like time constraints and a lack of local resources. They primarily target the South Asian market, with Sri Lanka as their primary market.

3 Need 1: Arterial Blood Speed Measuring Device

3.1 Introduction and Background

Accurately measuring arterial blood flow is super important in healthcare, especially during emergencies like accidents. It helps us figure out if blood vessels are working right or if there's a blockage that needs quick attention. Right now, we use blood speed measuring tools that rely on Doppler ultrasound tech. This tech sends out an ultrasound wave and checks how it bounces back from moving blood cells to see how fast the blood is flowing. But here's the catch: in Sri Lanka, these devices can cost around 2 lakhs or even more. That makes it hard for many folks to get their hands on them. We need a more affordable option designed for the local market. Better access means better diagnostics without breaking the bank.

3.2 Source in the medical field

Resource Person: A vascular surgeon from Teaching Hospital Peradeniya
We consulted a vascular surgeon from Teaching Hospital Peradeniya regarding the need for an affordable arterial blood speed measuring device. Their expertise highlighted the high cost and limited accessibility of current devices in Sri Lanka, which hampers timely diagnosis and treatment of vascular issues, especially in emergency situations.

3.3 Need Statement

Problem: Medical professionals often face challenges in assessing arterial blood flow in emergency situations, such as accidents, due to the high cost and limited accessibility of current Doppler-based blood speed measuring devices. This can delay critical diagnostics and treatment, particularly in resource-limited settings like Sri Lanka.
Population: Doctors and emergency medical professionals, as well as patients requiring immediate evaluation of blood flow, especially in trauma cases.
Outcome: Develop an affordable arterial blood speed measuring device using Doppler ultrasound technology, specifically designed for the Sri Lankan market, to improve accessibility, enhance diagnostic accuracy, and expedite emergency care.

3.4 Existing Solutions

Current methods to measure how fast blood moves in arteries use Doppler ultrasound technology. This tech is popular in hospitals for checking health. Companies like D-Brown, Siemens, and GE Healthcare make devices that are super accurate. They give quick info on blood flow speed, which is important for finding blockages or other blood vessel problems. These machines have fancy sensors that can measure without hurting the patient and do it well, but the problem is they can cost a lot, often more than 2 lakhs. That makes it hard to get to places like Sri Lanka. Because of the high price and the need for special training to run these machines, many healthcare providers can't adopt them easily in areas with limited resources.

Figure 1: Existing Device for Arterial Blood Speed Measuring

3.5 Stakeholder and Market Analysis

Hospitals and Clinics: Healthcare providers, especially in areas with few resources, can really boost their diagnostic skills with an affordable device that measures arterial blood speed. Faster diagnostics can mean quicker treatments. That's great for patient outcomes! Plus, hospitals won't spend as much on importing pricey equipment. They can also offer better services to more people.
Doctors and Emergency Medical Professionals: Doctors will get a handy, budget-friendly tool for checking blood flow in urgent situations. This helps them spot vascular problems quicker. Emergency professionals can make decisions fast, especially in trauma cases where keeping an eye on blood flow is super important.
Medical Device Manufacturers: Developing a low-cost Doppler-based blood speed measuring device opens a big chance in the market, especially in places like Sri Lanka. As more folks need easy-to-use diagnostic tools, manufacturers can reach out to underserved areas where low prices matter. Sure, the first costs of making them might be tough, but there's a great chance for lots of use because everyone wants affordable healthcare.

The market for monitoring blood flow devices is growing consistently. There's more cardiovascular disease and trauma happening around the world. Yet, the big challenge is still how affordable these devices are, particularly in developing countries. If we can provide a cost-effective solution, it might unlock new markets and help fulfill the rising wish for accessible medical diagnostics.

4 Need 2: Automated Laparoscopic Intracorporeal Knotting Device

4.1 Introduction and Background

Laparoscopic surgery is a common practice in the medical field because of its benefits of reduced recovery time, minimal scarring and lower risk of infection. However, intracorporeal knot tying, a key step in procedures such as suturing during laparoscopy, is one of the most technically challenging tasks for surgeons. The complexity of manually tying knots in a limited space can increase the risk of errors, increase the time of the surgery and lead to complications. The use of an automated device to perform laparoscopic knotting can reduce the technical burden on surgeons and reduce operation time.

4.2 Source in the medical field

Resource Person: A vascular surgeon from Teaching Hospital Peradeniya
Additionally, the surgeon emphasized the challenges faced during laparoscopic surgeries, specifically with intracorporeal knotting. The complexity of manually tying knots in small spaces increases the risk of surgical errors and extends operation times, highlighting the need for an automated knotting device to improve efficiency and reduce risks.

4.3 Need Statement

Problem: Surgeons face difficulties when doing intracorporeal knotting during laparoscopic surgeries due to the complexity of manually tying knots in small spaces which can increase the risk of surgical errors and extend operation times.
Population: Surgeons performing laparoscopic procedures and patients who are going through these surgeries.
Outcome: Create a device that automates intracorporeal knotting to improve surgical efficiency, reduce errors and decrease the time required for laparoscopic operations.

4.4 Existing Solutions

Current solutions to intracorporeal knot tying in laparoscopic surgery include manual knot tying techniques and the use of pre-tied knot devices. But these methods come with limitations:
Manual Knot Tying: requires a lot of training and precision. Surgeons must be highly skilled to tie knots in limited spaces, which can lead to fatigue, errors and extended surgery time.
Pre-Tied Knot Devices: Eventhough pre-tied knots reduce the technical challenge, they lack flexibility in terms of custom knot placement and tightness.

Automated devices that perform suturing exist, but they are either too complex or costly, with limited availability in many regions including Sri Lanka. There is still a significant gap in the development of a user-friendly device for automating intracorporeal knotting.

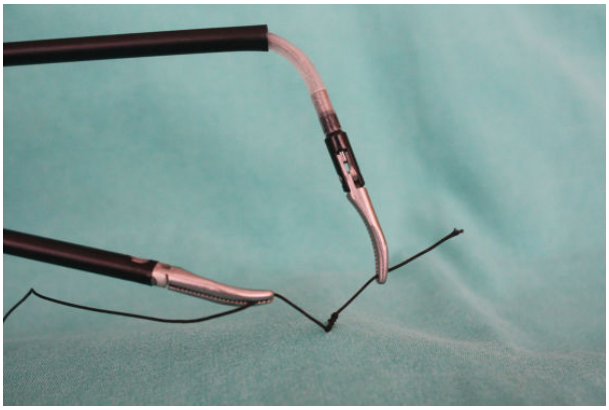

Figure 2: Existing Surgical Equipments for Intracorporeal Knotting

4.5 Stakeholder and Market Analysis

Patients: Patients who are going through laparoscopic surgery can benefit from shorter operation times, fewer complications and faster recovery as automated knotting can reduce surgical errors.
Surgeons: Surgeons will have an easier and more efficient method for knot tying, reducing stress and the probability of errors. Automation can free surgeons from repetitive time-consuming tasks and improve overall precision.
Hospitals and Surgical Centers: Healthcare providers can improve operating room efficiency and reduce costs associated with longer surgical procedures. Shorter surgery times also increase the number of surgeries that can be performed in a day improving income of the hospital.
Medical Device Manufacturers: The development of an automated intracorporeal knotting device presents a significant market opportunity. As laparoscopic surgery continues to expand globally, there is increasing demand for tools that improve surgical efficiency and outcomes.

The global market for laparoscopic devices is drastically increasing with the rising demand for minimally invasive surgeries. As the market expands, there is an increasing need for automation in surgical tasks that are time-consuming or technically challenging. An automated intracorporeal knotting device can meet this demand by improving surgeon performance and patient outcomes. Challenge may be the initial cost of developing and marketing the device, but the potential for widespread usage is high due to the benefits in terms of efficiency and safety. The market for such devices is expected to increase, especially in developed countries where laparoscopic surgeries are widely used.

5 Need 3: Low-Cost Wireless sEMG Signal Detection System for Wrists

5.1 Introduction and Background

Surface electromyography (sEMG) is a widely used technique to assess muscle activity and performance. Monitoring muscle health and performance is crucial for athletes, especially to track muscle fatigue, recovery, and potential abnormalities. Wrist muscles are particularly prone to fatigue due to repetitive movements in sports such as tennis, golf, and weightlifting. Traditional sEMG systems can be bulky, wired, and impractical for daily use. A wireless sEMG signal detection system for the wrist would provide real-time muscle monitoring in a convenient and wearable format, offering athletes a better idea of their muscle condition and performance while reducing the risk of injury.

5.2 Source in the medical field

Resource Person: A 2nd year MBBS undergraduate from University of Colombo
He provided us with the discussed problem and the need for a low cost wireless sEMG system for people specially in the field of sports.

5.3 Need Statement

Problem: Athletes often face challenges in monitoring their wrist muscles' health and performance due to limitations in existing wired sEMG devices, which are bulky and unsuitable for daily, real-time tracking of muscle fatigue and abnormalities.
Population: Athletes and sportspersons who require daily monitoring of their wrist muscles to assess fatigue, prevent injury, and ensure optimal performance at a reasonable cost.
Outcome: Develop a wireless sEMG detection system for wrists that allows real-time monitoring of muscle fatigue and abnormalities. This system should improve athletic performance, prevent injuries, and enable daily, non-invasive monitoring.

5.4 Existing Solutions

Current sEMG systems include wired devices and sensors placed on the skin to detect muscle activity. While effective for clinical settings, they pose several limitations in sports and daily use:
Wired sEMG Devices: Though accurate, these systems limit movement, making them unsuitable for dynamic sports. The wires and bulky setup create discomfort, which can distract athletes from their activities.
Wearable Fitness Trackers: Some devices monitor general muscle performance, but they lack the precision of sEMG for detecting muscle fatigue and specific abnormalities.
Wireless sEMG Devices: Existing wireless options are often expensive, and their bulkiness reduces comfort, particularly for sportspersons who need lightweight, flexible, and user-friendly designs.

There is a significant opportunity for a lightweight, wireless sEMG system that is cost-effective and designed specifically for daily monitoring of wrist muscles.

5.5 Stakeholder and Market Analysis

Athletes and Sportspersons: Athletes can benefit from precise, real-time data on wrist muscle performance, helping prevent overuse injuries, fatigue, and abnormal strain. Daily monitoring ensures better recovery and peak performance during training and competition.
Sports Medicine and Rehabilitation Professionals: A wireless sEMG system enables sports doctors and physiotherapists to monitor and track muscle health remotely, adjusting training or recovery programs based on real-time data.
Fitness Trainers: Coaches and trainers can use this device to improve training schedules by understanding an athlete's muscle fatigue and recovery needs more accurately.
Medical Device Manufacturers: There is a strong market for wearable, non-invasive, real-time monitoring devices in the sports and healthcare industries. The growing interest in personalized health data tracking provides a good opportunity for manufacturers.

The market for wireless sEMG devices is expanding as athletes and healthcare professionals seek more sophisticated tools for performance monitoring and injury prevention. This device can be a cost-effective solution for continuous wrist muscle monitoring, appealing to both professionals and everyday athletes. Though initial development and production costs may pose a challenge, the potential for widespread usage in sports medicine and fitness is significant, particularly in regions where injury prevention and performance tracking are a priority.

Figure 3: Wrist Muscle Activity Monitoring - An Improved Method

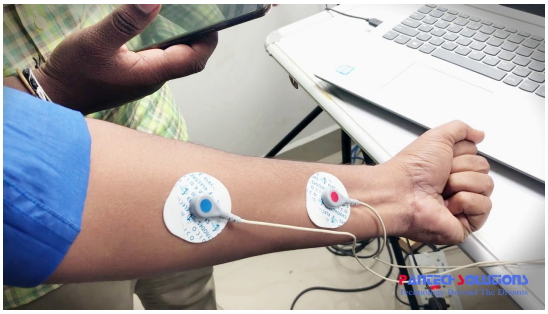

Figure 4: Wrist Muscle Activity Monitoring - A Conventional Method

6 Needs Screening

We considered the above problems and carried out a screening process by allocating marks. Then we selected the most suitable problem by the rankings.

Need	**Estimated market** Out of 5	**Patient impact** Out of 3	**Providers impact** Out of 5	**Feasibility index** Out of 5	**Co-owners Preference** Out of 3			**Total** Out of 27	**Rank**
					I	II	III		
Arterial Blood Speed Measuring Device	4	2	4	3	3	3	2	21	2
Automated Laparoscopic Intracorporeal Knotting Device	4	3	4	3	1	2	3	20	3
Low-Cost Wireless sEMG Signal Detection System for Wrists	5	2	4	4	3	2	3	23	1

7 Conclusion

In conclusion, we identified "Need 3: Low-Cost Wireless sEMG Signal Detection System for Wrists" as it meets a vital demand for real-time, non-invasive muscle activity monitoring. This tool can provide insightful information about how muscles work, which is helpful for clinical diagnoses, sports performance, and rehabilitation. In comparison to the other demands, it is a highly influential initiative because of its potential to improve patient care and provide more effective muscle testing in a variety of contexts.

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