TALLINN UNIVERSITY OF TECHNOLOGY
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THE DESIGN OF OPTICAL FIBER ASSEMBLY SYSTEM

VALGUSKIUDUDE PAIGALDUSSEADME PROJEKTEERIMINE

MASTER THESIS

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SUMMARY

The increase in terrorism, transporting weapons and illegal goods is becoming a bigger problem globally day by day. Safe and effective cargo scanning is very much needed in many fields to improve security. Fortunately, with the technology of nowadays we can change the narrative.

The aim of this thesis was to develop a device that can produce fiber panels which are used inside new generation scanning system to make world safer and cargo scanning more effective. During the development process unique conception of the device was created to produce fiber panels. The author concentrated mostly on mechanical engineering and project management tasks during development process.

In the literature review it turned out that there isn’t any beneficial information that can be used while developing a device. This topic is very specific and devices with such a concept haven’t been manufactured before. Therefore, the decision was made to design the machine by the author himself.

The third chapter shows the machine design process. First, robots and suitable components for dispensing and curing the glue were picked. The robot heads were constructed, after which the robots were attached to support frame and the solution was validated using FEM analysis. The next step was to design a feeder system that feeds the fiber on the spool to the robot's head. After that, the components were selected and the solution of the linear axes was constructed. The solution was validated using FEM analysis. Finally, a base frame was designed with a worktable on it on which can be used to fix and position base plates on it. The base frame design was validated using FEM analysis.

The fourth chapter provides an overview of the safety of the machine and how to ensure the safety of the operator. The safety fence and light curtains prevent the operator from entering the work zone. It is important that the operator cannot enter the work zone when the device is operating.

The fifth chapter presents economic calculations. This chapter gives a simple overview of the costs and the total cost of the device.

As a result of this work, a new concept of the device was successfully generated. In the thesis, a fiber panel assembly device was designed and can be used to produce prototype. The aim of the thesis was fulfilled. Further developments activities in the future that can be performed are following:

1. Considering using the Z-axis instead of robots;
2. Considering how to insert several fibers into a groove at the same time;
3. Communication improvement between robots and linear axes.

KOKKUVÕTE

Terrorismi, relvade ja illegaalsete kaupade transpordi kasv on muutumas iga päevaga üha suuremaks probleemiks üle maailma. Ohutut, tõhusat ja turvalist kauba skaneerimist on turvalisuse parandamiseks paljudes valdkondades väga vaja. Õnneks saame tänapäeva tehnoloogia abil narratiivi muuta.

Lõputöö eesmärgiks oli välja töötada seade, mis suudab toota fiiberkiudpaneele, mida kasutatakse uue põlvkonna skaneerimissüsteemis, et muuta maailm turvalisemaks ja kauba skaneerimine efektiivsemaks. Arendusprotsessi käigus loodi ainulaadne kontseptsioon kiudpaneelide tootmiseks. Autor keskendus arendusprotsessides peamiselt masinaehitus- ja projektijuhtimisülesannetele.

Kirjanduse ülevaatest selgus, et sellise tehnoloogia jaoks vajalik informatsioon puudub. Antud teema on väga spetsiifiline ja sellise kontseptsiooniga seadmeid pole varem toodetud. Seetõttu otsustati ise selline masin disainida.

Kolmas peatükk keskendub masina projekteerimise protsessile. Kõigepealt valiti välja robotid ja sobivad komponendid liimi doseerimiseks ja kuivatamiseks. Seejärel konstrueeriti roboti tööpead, peale mida konstrueeriti kinnitus, mida saab kasutada robotite kinnitamiseks telje külge. Seejärel valideeriti lahendus kasutades FEM-analüüsi. Järgmiseks sammuks oli etteande süsteemi projekteerimine, mis söödab pooli peal olevat fiibrit roboti tööpeale ette. Peale seda valiti komponendid ja konstrueeriti lineaartelgede lahendus. Lahendus valideeriti kasutades FEM-analüüsi. Lõpetuseks projekteeriti alusraam koos töölauaga, millele saab kinnitada ja positsioneerida fiiberplaate. Alusraami disain sai valideeritud kasutades FEM analüüsi.

Neljandas peatükis antakse ülevaade masina ohutusest ning ohutuse tagamisest operaatorile. Turvaaed ja turvakardinad takistavad operaatoril pääsemast töötsooni. On oluline, et operaator ei saaks minna töötsooni kui masina tööprotsess on pooleli.

Viiendas peatükis on välja toodud majanduslikud arvutused. See peatükk annab lihtsa ülevaate seadmega kaasnevatest kuludest ja seadme maksumusest.

Antud töö tulemusena genereeriti edukalt uudne kontseptsioon fiiberpaneeli koostamise seadmele. Töös projekteeriti fiiberpaneelide koostamise seadme lahendus, mida saab kasutada prototüübi valmistamiseks. Töö eesmärk sai täidetud. Edasised arengusuunad, mida tulevikus uurida on järgnevad:

1. Kaaluda võimalust, kus robotite asemel on kasutuses Z-telg;
2. Kaaluda võimalust, kuidas panna mitu fiibrit samaaegselt soonde;
3. Robotite ja lineaartelgede vahelise kommunikatsiooni parendamine.